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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics.*

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77 THERMODYNAMICS AND STATISTICAL PHYSICS 2284
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For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) 2285
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT N.A.
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 2285
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS N.A.
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 2286
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 2287
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2287
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 2290
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 2290
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 2290
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 2290
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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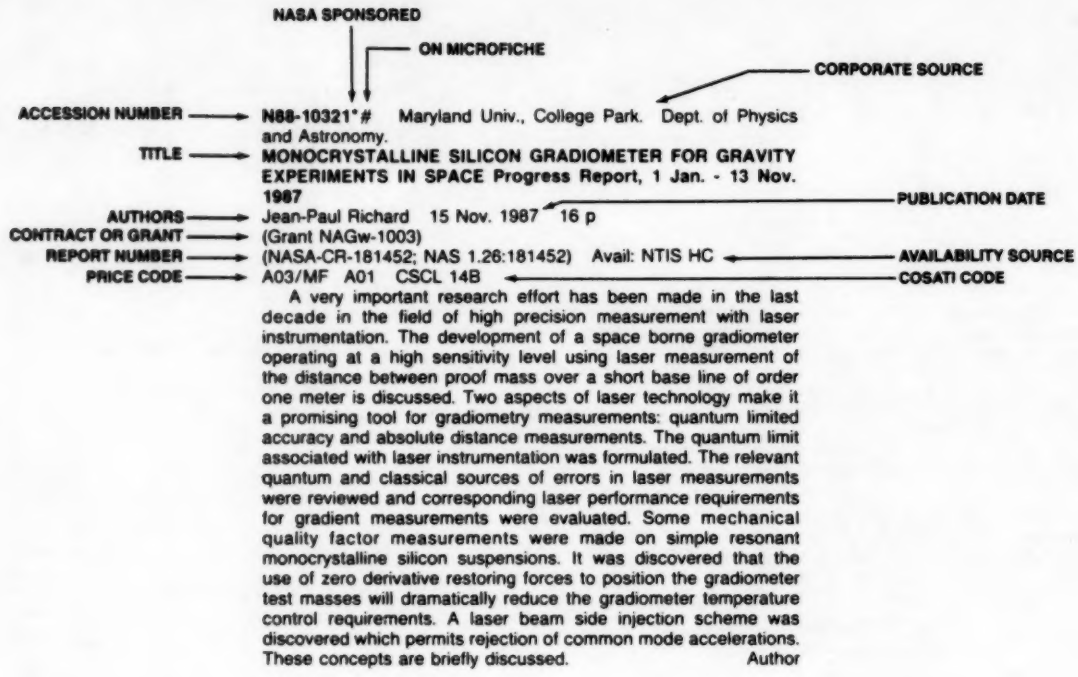
NASA SPONSORED
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CORPORATE SOURCE
ACCESSION NUMBER
N88-10321*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
TITLE
MONOCRYSTALLINE SILICON GRADIOMETER FOR GRAVITY EXPERIMENTS IN SPACE Progress Report, 1 Jan. - 13 Nov. 1987
PUBLICATION DATE
AUTHORS
Jean-Paul Richard 15 Nov. 1987 16 p
CONTRACT OR GRANT
(Grant NAGw-1003)
REPORT NUMBER
(NASA-CR-181452; NAS 1.26:181452) Avail: NTIS HC
AVAILABILITY SOURCE
PRICE CODE
A03/MF A01 CSCL 14B
COSATI CODE
A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 16/ AUGUST 23, 1988

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N88-22855 Deutsche Lufthansa Aktiengesellschaft, Cologne (West Germany).
[ACTIVITIES REPORT OF LUFTHANSA] Annual Report, 1987 [LUFTHANSA JAHRBUCH '87]
Hans-Joachim Aligaier, ed. 31 May 1987 309 p In GERMAN (ISSN-0176-5086; ETN-88-91474) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The economic significance of Lufthansa; Lufthansa in the capital market; flight as a financial problem; pilot education; responsibility of the aircraft captain; aircraft safety; use of twin-engine long distance aircraft; customer information; operation of the Frankfurt air freight center; and Airbus Industries are discussed. The evolution of European air traffic policy; extraterrestrial application of air law, and the status of aircraft engineering are reviewed. ESA

N88-22856# Fokker B.V., Amsterdam (Netherlands).
[ACTIVITIES REPORT IN AEROSPACE] Annual Report, 1986 [JAARVERSLAG 1986]
1986 60 p In DUTCH Original contains color illustrations (ETN-88-91566) Avail: NTIS HC A04/MF A01

The development, production, and commercial activities related to the F-27 Friendship, Fokker 50, Fokker 100, Airbus 300, Airbus 310, Short 330, Short 360, and F-16 are summarized. Planned research activities in astronautics are mentioned. ESA

N88-22857* National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 226)
May 1988 146 p
(NASA-SP-7037(226); NAS 1.21:7037(226)) Avail: NTIS HC A07 CSCL 01A

This bibliography lists 515 reports, articles, and other documents introduced into the NASA scientific and technical information system in April, 1988. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-22858# National Aerospace Lab., Tokyo (Japan).
OIL FLOW PATTERNS ON A SERIES OF CAPSULE-TYPE RE-ENTRY VEHICLES AT HYPERSONIC SPEEDS
Yukimitsu Yamamoto, Mitsunori Watanabe, Shigeaki Nomura, Tadao Koyama, Koichi Hozeki, Akira Yoshizawa, Tetsuichi Ito, and Hitoshi Takatsuka Nov. 1986 49 p In JAPANESE; ENGLISH summary
(DE88-751805; NAL-TM-557) Avail: NTIS (US Sales Only) HC A03

Oil flow visualization tests are made to examine various fore- and afterbody flow patterns on a series of capsule-type vehicles at a Mach number of 7.1 and at angles of attack from 10 to 20 deg. The Reynolds number is varied from 4.5 x 10 to 1.8 x 10 per unit length cm. Two types of model configurations are used for the tests: blunt cone (S-type) and combination of a reverse cone and a cylinder (M-type). In S-type models, axial oil separation does not occur at an angle of attack of 20 deg, though the shear stress at the surface increases as the Reynolds number is raised. In M-type models, separation takes place at 20 deg on the back surface just downstream of the shoulder, and the pressure on the cylinder portion becomes higher at this angle than at 10 deg, resulting in a decreased distance between the separation point and the reattachment point. Other three-dimensional separation/reattachment flows in a hypersonic region are also analyzed in detail based on a series of oil flow tests to clarify basic characteristics. DOE

N88-22859# National Aerospace Lab., Tokyo (Japan).
DESIGN METHOD FOR LAMINAR FLOW CONTROL OF TWO-DIMENSIONAL AIRFOILS IN INCOMPRESSIBLE FLOW. NUMERICAL STUDY OF LFC DESIGN CONCEPTS
Yoji Ishida Nov. 1986 16 p In JAPANESE; ENGLISH summary
(DE88-751809; NAL-TR-920) Avail: NTIS (US Sales Only) HC A03

A laminar flow control technology aims to greatly reduct the frictional resistance on the airfoil surface by retaining the laminar flow by stabilizing the boundary layer on the surface of the airfoil by sucking. It is an effective procedure to prepare, by calculation, a few design concepts with excellent characteristics and to carry out an experimental verification. The calculation method is composed of boundary layers for laminar, translational, and turbulent flow. Calculation of boundary layers put basis on Kellers box scheme (differential decomposition methods of boundary layer equation), and criterion of transition point used Cebeci-Smith's algebraic model. Both continuous and discrete models were used for suction. Effect of frictional resistance reduction, effect of dissipating suction, effect of sucking position, and hybrid laminar flow control were examined. This method seems useful for a parametric study of laminar flow control airfoil design. DOE

N88-22860# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Zellenaerodynamik.
A MULTILIFTING LINE METHOD AND ITS APPLICATION IN DESIGN AND ANALYSIS OF NONPLANAR WING CONFIGURATIONS Ph.D. Thesis - Technische Univ., Brunswick, Fed. Republic of Germany
Karl-Heinz Horstmann Dec. 1987 148 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-51; ISSN-0171-1342; ETN-88-92323) Avail: NTIS HC A07/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 45 DM

A calculation method for nonplanar wing geometries having discrete bound vortices at the 1/4-lines of panels is described. Instead of the discrete trailing vortices of the vortex lattice singularity model, a trailing vortex sheet having a continuously distributed vortex strength is employed. The bound vortex strength is a steady function of the spanwise position. This function is assumed to be parabolic on each panel, so the vortex strength of the trailing vortices has a linear behavior in spanwise direction.

This singularity model is employed in an analysis and in a design method which allows the design of nonplanar wings having minimum induced drag. Calculations with different geometries show that the accuracy of the method for load distribution and induced drag is as good as that of lifting surface theories. ESA

N88-22861# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.

EXPERIMENTAL INVESTIGATION OF THE TRANSONIC FLOW AT THE LEEWARD SIDE OF A DELTA WING AT HIGH INCIDENCE

Z. M. Houtman and W. J. Bannink Aug. 1987 43 p
(LR-518; B8733283; ETN-88-92461) Avail: NTIS HC A03/MF A01

The transonic flow field at the leeward side of a cropped delta wing with a sweep angle of 65 deg mounted on a cylindrical body having an ogival nose was studied at a free stream Mach number of 0.85 and at angles of incidence of 10 and 20 deg. Measurements show a complex flow containing dominant regions of vortices, embedded shock waves, and separations. In spite of the transonic flow and the presence of a body extending in front of the wing apex a large part of the flow field may be regarded as conical. At an incidence of 20 deg a strong shock wave is observed at 80 percent chord position terminating a region of locally supersonic flow; the shock stands across the wing symmetry plane but its actual shape is unknown. Evidence of a nonconical shock between the primary vortex and the wing surface, probably generated by the upstream influence of the cropped wing tips and of the trailing edge is obtained. Both shocks interfere quite strongly with the vortex system. Indications for a conical shock above the leading edge vortex are found. ESA

N88-22862*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Mechanics.

A NUMERICAL MODEL OF UNSTEADY, SUBSONIC AEROELASTIC BEHAVIOR Ph.D Thesis

Thomas W. Strganac Aug. 1987 123 p Sponsored by NASA
Original document contains color illustrations
(NASA-TM-101126; NAS 1.15:101126) Avail: NTIS HC A06/MF A01 CSCL 01A

A method for predicting unsteady, subsonic aeroelastic responses was developed. The technique accounts for aerodynamic nonlinearities associated with angles of attack, vortex-dominated flow, static deformations, and unsteady behavior. The fluid and the wing together are treated as a single dynamical system, and the equations of motion for the structure and flow field are integrated simultaneously and interactively in the time domain. The method employs an iterative scheme based on a predictor-corrector technique. The aerodynamic loads are computed by the general unsteady vortex-lattice method and are determined simultaneously with the motion of the wing. Because the unsteady vortex-lattice method predicts the wake as part of the solution, the history of the motion is taken into account; hysteresis is predicted. Two models are used to demonstrate the technique: a rigid wing on an elastic support experiencing plunge and pitch about the elastic axis, and an elastic wing rigidly supported at the root chord experiencing spanwise bending and twisting. The method can be readily extended to account for structural nonlinearities and/or substitute aerodynamic load models. The time domain solution coupled with the unsteady vortex-lattice method provides the capability of graphically depicting wing and wake motion. Author

N88-22863*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INFLOW MEASUREMENTS MADE WITH A LASER VELOCIMETER ON A HELICOPTER MODEL IN FORWARD FLIGHT. VOLUME 4: TAPERED PLANFORM BLADES AT AN ADVANCE RATIO OF 0.15

Susan L. Althoff, Joe W. Elliott, and Richard H. Sailey (PRC Kentron, Inc., Hampton, Va.) Apr. 1988 322 p Also includes floppy disk format
(NASA-TM-100544; AVSCOM-TM-88-B-007; NAS 1.15:100544)
Avail: NTIS HC A14/MF A01 CSCL 01A

An experimental investigation was conducted in the 14- by 22-Foot Subsonic Tunnel at NASA Langley Research Center to measure the inflow into the scale model helicopter rotor in forward flight (mu sub infinity = 0.15). The measurements were made with a two-component Laser Velocimeter (LV) one chord above the plane formed by the path of the rotor tips (tip path plane). A conditional sampling technique was employed to determine the position of the rotor at the time that each velocity measurement was made so that the azimuthal fluctuations in velocity could be determined. Measurements were made at a total of 146 separate locations in order to clearly define the inflow character. This data is presented herein without analysis. In order to increase the availability of the resulting data, both the mean and azimuthally dependent values are included as part of this report on two 5.25 inch floppy disks in MS-DOS format. Author

N88-22864*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ON THE VALIDATION OF A CODE AND A TURBULENCE MODEL APPROPRIATE TO CIRCULATION CONTROL AIRFOILS

J. R. Viegas, M. W. Rubesin, and R. W. MacCormack (Stanford Univ., Calif.) Apr. 1988 25 p
(NASA-TM-100090; A-88127; NAS 1.15:100090) Avail: NTIS HC A03/MF A01 CSCL 01A

A computer code for calculating flow about a circulation control airfoil within a wind tunnel test section has been developed. This code is being validated for eventual use as an aid to design such airfoils. The concept of code validation being used is explained. The initial stages of the process have been accomplished. The present code has been applied to a low-subsonic, 2-D flow about a circulation control airfoil for which extensive data exist. Two basic turbulence models and variants thereof have been successfully introduced into the algorithm, the Baldwin-Lomax algebraic and the Jones-Launder two-equation models of turbulence. The variants include adding a history of the jet development for the algebraic model and adding streamwise curvature effects for both models. Numerical difficulties and difficulties in the validation process are discussed. Turbulence model and code improvements to proceed with the validation process are also discussed. Author

N88-22865*# Southampton Univ. (England).

AEROFOIL TESTING IN A SELF-STREAMLINING FLEXIBLE WALLED WIND TUNNEL Ph.D. Thesis - Jul. 1987

Mark Charles Lewis Washington NASA May 1988 271 p
(Grant NsG-7172)
(NASA-CR-4128; NAS 1.26:4128) Avail: NTIS HC A12/MF A01 CSCL 01A

Two-dimensional self-streamlining flexible walled test sections eliminate, as far as experimentally possible, the top and bottom wall interference effects in transonic airfoil testing. The test section sidewalls are rigid, while the impervious top and bottom walls are flexible and contoured to streamline shapes by a system of jacks, without reference to the airfoil model. The concept of wall contouring to eliminate or minimize test section boundary interference in 2-D testing was first demonstrated by NPL in England during the early 40's. The transonic streamlining strategy proposed, developed and used by NPL has been compared with several modern strategies. The NPL strategy has proved to be surprisingly good at providing a wall interference-free test environment, giving model performance indistinguishable from that obtained using the modern strategies over a wide range of test conditions. In all previous investigations the achievement of wall streamlining in flexible walled test sections has been limited to test sections up to those resulting in the model's shock just extending to a streamlined wall. This work however, has also successfully demonstrated the feasibility of 2-D wall streamlining at test conditions where both model shocks have reached and penetrated through their respective flexible walls. Appropriate

streamlining procedures have been established and are uncomplicated, enabling flexible walled test sections to cope easily with these high transonic flows. Author

N88-22866*# McDonnell Aircraft Co., St. Louis, Mo.
PROPULSION AND AIRFRAME AERODYNAMIC INTERACTIONS OF SUPERSONIC V/STOL CONFIGURATIONS. VOLUME 1: WIND TUNNEL TEST PRESSURE DATA REPORT
D. E. Zilz and P. A. Devereaux Sep. 1985 885 p
(Contract NAS2-10791)
(NASA-CR-177343-Vol-1; NAS 1.26:177343-Vol-1) Avail: NTIS HC A99/MF E03 CSCL 01A

A wind tunnel model of a supersonic V/STOL fighter configuration has been tested to measure the aerodynamic interaction effects which can result from geometrically close-coupled propulsion system/airframe components. The approach was to configure the model to represent two different test techniques. One was a conventional test technique composed of two test modes. In the Flow-Through mode, absolute configuration aerodynamics are measured, including inlet/airframe interactions. In the Jet-Effects mode, incremental nozzle/airframe interactions are measured. The other test technique is a propulsion simulator approach, where a sub-scale, externally powered engine is mounted in the model. This allows proper measurement of inlet/airframe and nozzle/airframe interactions simultaneously. This is Volume 1 of 2: Wind Tunnel Test Pressure Data Report. Author

N88-22867*# McDonnell Aircraft Co., St. Louis, Mo.
PROPULSION AND AIRFRAME AERODYNAMIC INTERACTIONS OF SUPERSONIC V/STOL CONFIGURATIONS. VOLUME 2: WIND TUNNEL TEST FORCE AND MOMENT DATA REPORT
D. E. Zilz Sep. 1985 328 p
(Contract NAS2-10791)
(NASA-CR-177343-Vol-2; NAS 1.26:177343-Vol-2) Avail: NTIS HC A15/MF A01 CSCL 01A

A wind tunnel model of a supersonic V/STOL fighter configuration has been tested to measure the aerodynamic interaction effects which can result from geometrically close-coupled propulsion system/airframe components. The approach was to configure the model to represent two different test techniques. One was a conventional test technique composed of two test modes. In the Flow-Through mode, absolute configuration aerodynamics are measured, including inlet/airframe interactions. In the Jet-Effects mode, incremental nozzle/airframe interactions are measured. The other test technique is a propulsion simulator approach, where a sub-scale, externally powered engine is mounted in the model. This allows proper measurement of inlet/airframe and nozzle/airframe interactions simultaneously. This is Volume 2 of 2: Wind Tunnel Test Force and Moment Data Report. Author

N88-22868*# McDonnell Aircraft Co., St. Louis, Mo.
PROPULSION AND AIRFRAME AERODYNAMIC INTERACTIONS OF SUPERSONIC V/STOL CONFIGURATIONS. VOLUME 4: SUMMARY Final Report
D. E. Zilz, H. W. Wallace, and P. E. Hiley Sep. 1985 88 p
(Contract NAS2-10791)
(NASA-CR-177343-Vol-4; NAS 1.26:177343-Vol-4) Avail: NTIS HC A05/MF A01 CSCL 01A

A wind tunnel model of a supersonic V/STOL fighter configuration has been tested to measure the aerodynamic interaction effects which can result from geometrically close-coupled propulsion system/airframe components. The approach was to configure the model to represent two different test techniques. One was a conventional test technique composed of two test modes. In the Flow-Through mode, absolute configuration aerodynamics are measured, including inlet/airframe interactions. In the Jet-Effects mode, incremental nozzle/airframe interactions are measured. The other test technique is a propulsion simulator approach, where a sub-scale, externally powered engine is mounted in the model. This allows proper measurement of inlet/airframe and nozzle/airframe interactions simultaneously. This is Volume 4 of 4: Final Report- Summary. Author

N88-22869# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ANALYSIS FOR HIGH COMPRESSIBLE SUPERSONIC FLOW IN CONVERGING NOZZLE
Keishiro Niu and Takayuki Aoki (Tokyo Inst. of Tech., Yokahama, Japan) Feb. 1988 16 p
(IPPJ-860; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

In a converging nozzle, fluid is shown to be compressed to a very high density, especially in the supersonic region, if the initial Mach number of the fluid is large. Thus it is shown that spherical implosion can be used as a method to make high density materials. Author

N88-22870# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
THE STRUCTURE OF SONIC UNDEREXPANDED TURBULENT AIR JETS IN STILL AIR Interim Report, 15 Jul. 1985 - 15 Aug. 1987
S. G. Chuech, M. C. Lai, and G. M. Faeth Sep. 1987 118 p
(Contract N00014-85-K-0604)
(AD-A190856) Avail: NTIS HC A06/MF A01 CSCL 20D

Turbulent subsonic, sonic and underexpanded round air jets, in still air, were studied both theoretically and experimentally. The following measurements were made: shock-wave structure of the underexpanded jets, using flash and continuous schlieren photography; mean and fluctuating concentrations and mean static pressures, using laser-induced fluorescence; and mean and fluctuating streamwise velocities, using laser-Doppler anemometry. Analysis included: solution of the parabolized Navier-Stokes equations of motion; and use of effective adapted-jet exit conditions, to avoid the complexities of treating the shock-containing near field region of underexpanded jets. In both cases, turbulence properties were found using a k-epsilon turbulence model. Structure of the near-field region of the underexpanded jets was influenced by compressibility and turbulence levels at the jet exit. Mixing rates were reduced by compressibility when convective Mach numbers were greater than 0.5, in agreement with observations of Papamoschou and Roshko (1986); while increased turbulence levels at the jet exit increased mixing rates, which is a well-recognized effect for subsonic jets. The present parabolized Navier-Stokes method was successful for treating slug-flow exit conditions, but must be extended to treat effects of turbulent jet exit conditions. GRA

N88-22871# State Univ. of New York, Old Westbury.
EXPERIMENTAL INVESTIGATION OF THE HYPERSONIC FLOW OVER A SIX FINNED CONFIGURATION Final Report
A. M. Agnone, V. Zakkay, and K. S. Parmar Jun. 1987 47 p
(Contract DAAG29-83-K-0115)
(AD-A190870; ARO-20723.3-EG) Avail: NTIS HC A03/MF A01 CSCL 16B

Experimental data of the flow field over a six-finned configuration are compared with computations from an inviscid Euler and a parabolized Navier-Stokes (PNS) code to assess their accuracy. The experiments were conducted with a smooth and a grooved cylinder in a hypersonic (M=6.5) wind tunnel. Surface oil flow patterns, surface pressures, local heat flux rates and flow field pitot surveys are presented. The PNS computations are in good agreement with the measurements in the viscid regions. However, significant differences are noted in the viscous regions possibly due to nose tip bluntness effects and the associated entropy layer. GRA

N88-22872# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering and Applied Mechanics.
COMPUTER TOMOGRAPHY AND HYBRID OPTICAL/DIGITAL METHODS FOR AERODYNAMIC MEASUREMENTS Final Report, 1 Jan. 1984 - 28 Dec. 1987
C. M. Vest 28 Dec. 1987 44 p

(Contract DAAG29-83-K-0139)
(AD-A190909; ARO-20740.5-EG) Avail: NTIS HC A03/MF A01 CSCL 01A

A hybrid optical/digital system has been developed to measure instantaneous, three-dimensional, density distributions in aerodynamic flows. The system uses a pulsed laser and discrete phase-step holographic interferometry, resulting in excellent phase resolution and a substantial level of automation of phase readout. The system uses reflection-, as well as transmission-, holography. Data are analyzed by computer tomography using a new algorithm (constrained iterative convolution) developed during this program. The entire system was used to study turbulent helium jets, disclosing their basic structures. Research also was conducted to develop methods for computer tomographic analysis when the optical probing rays are bent due to strong refraction, e.g., around shocks. Two iterative methods and a perturbation approach is recommended. GRA

N88-22873# PEDA Corp., Palo Alto, Calif.
EFFICIENT, HIGH RESOLUTION COMPUTATIONS OF PROJECTILE AND MISSILE FLOW FIELDS Final Report, 15 Mar. 1984 - 14 Sep. 1987
C. K. Lombard, Jorge Bardina, R. C. Luh, and Ethiraj Venkatapathy Dec. 1987 33 p
(Contract DAAG29-84-C-0002)
(AD-A191086; ARO-21247.6-EG-S) Avail: NTIS HC A03/MF A01 CSCL 20D

A new family of computational tools is explored in the context of generic problems of interest to Army Research and Development missions. The problems are the SOCBT projectile flow and the MICOM model tactical base flow. Both problems, for which experimental data is available for comparison, were also extensively computed by other groups with other methods, principally the central difference method of Beam and Warning. Here, the techniques we employ and to some extent refine are composite and overset patched mesh systems generated with a new multistep, graphics interactive algebraic procedure FASTWO and the CSCM-S symmetric Gauss-Seidel relaxation procedure. The grid generation technique permits comparatively simple direct user control of mesh spacing and quality. The CSCM-S algorithm is an alternating direction space marching method of lines in 2-D and planes in 3-D. The method is economical both in storage and data handling and, also, is rapidly convergent as the result of improved propagation of nonlinear advection, boundary to boundary. In the SOCBT problem the method exhibited convergence in order 100 global iterations and showed improved accuracy vis-a-vis central difference methods in capturing features of the flow such as shocks and expansions. GRA

N88-22874# JAI Associates, Mountain View, Calif.
TIP VORTICES OF ISOLATED WINGS AND HELICOPTER ROTOR BLADES Final Report, Nov. 1984 - Nov. 1987
Ganapathi R. Srinivasan Dec. 1987 86 p
(Contract DAAG29-85-C-0002)
(AD-A191336; JAIA-TR-87-01; R/D-5378-PH-01) Avail: NTIS HC A05/MF A01 CSCL 01A

Thin layer Navier-Stokes equations are solved numerically for simulating the flowfields of isolated wings and helicopter rotor blades with a particular emphasis on understanding the formation and roll-up of tip vortices in subsonic and transonic flows. Several test cases consisting of wings and rotor blades of different planforms have been considered to examine the influence of the tip-cap shape, the tip-planform, the freestream Mach number, and the effect of centrifugal forces of rotation. A fairly good definition of the formation and roll-up of the tip vortex is demonstrated for all the cases considered here. Finally, the calculated lift, drag and pitching-moment coefficients agree well with the experimentally determined values, where available. Alternate methods of simulating the hovering rotor flowfields in blade-fixed mode that have the circulation distribution as hovering blade are explored. The results and discussion are presented. GRA

N88-22875# Dayton Univ., Ohio. Research Inst.
AN INTEGRAL EQUATION FOR THE LINEARIZED SUPERSONIC FLOW OVER A WING Interim Report, Nov. 1986 - Aug. 1987
Karl G. Guderley Feb. 1988 112 p
(Contract F33615-86-C-3200)
(AD-A191408; UDR-TR-87-91; AFWAL-TR-87-3097) Avail: NTIS HC A06/MF A01 CSCL 01A

In the first formulation, the integral equation for linearized steady supersonic flows appears in a form where it is necessary to approach the planform from above or below by a limiting process. In the present report, the problem is transformed analytically in such a manner that this limiting process no longer appears and that the resulting expressions are numerically tractable. It is believed that such a formulation gives more freedom to take the particularities of a given problem into account. The formulation is applied to compute the conical field which arises at the top of an airfoil. A possible numerical approach to the solution of the integral equation in the general case is described, but only in a rough outline. GRA

N88-23245*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
THE 2-D AND 3-D TIME MARCHING TRANSONIC POTENTIAL FLOW METHOD FOR PROPFANS
Marc H. Williams *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 263-271 (For primary document see N88-23226 16-39)
(Grant NAG3-499)
Avail: NTIS HC A20/MF A01 CSCL 01A

N88-23246*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
PROPFAN MODEL WIND TUNNEL AEROELASTIC RESEARCH RESULTS
Oral Mehmed *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 273-286 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 01A

N88-23248*# Duke Univ., Durham, N. C. Dept. of Mechanical Engineering and Materials Science.
REDUCED ORDER MODELS FOR NONLINEAR AERODYNAMICS
Aparajit J. Mahajan, Earl H. Dowell, and Donald B. Bliss *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 299-308 (For primary document see N88-23226 16-39)
(Grant NAG3-724)
Avail: NTIS HC A20/MF A01 CSCL 01A

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-22876# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Meteorologisch Fernerkundung.
BIBLIOGRAPHY OF ICING ON AIRCRAFT (STATUS 1987)
Klaus-Peter Schickel and Werner Fuchs Oct. 1987 38 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-87-18; ISSN-0176-7739; ETN-88-92310) Avail: NTIS HC A03/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 12.50 DM

Over 140 references on aircraft icing, particularly helicopters, are presented. The contributions of satellite imagery and personal

computers to forecasting cloud icing and aircraft icing is stressed. ESA

N88-22877# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.
AIRCRAFT ACCIDENT REPORT: MIDAIR COLLISION OF US ARMY U-21A, ARMY 18061 AND SACHS ELECTRIC COMPANY PIPER PA-31-350, N60SE, INDEPENDENCE, MISSOURI, JANUARY 20, 1987
3 Feb. 1988 61 p
(PB88-910401; NTSB-AAR-88-01) Avail: NTIS HC A04/MF A01; also available on subscription, North American Continent HC $70.00/year; all others write for quote CSCL 01C

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the radar controllers to detect the conflict and to issue traffic advisories or a safety alert to the flightcrew of the U-21; deficiencies of the see and avoid concept as a primary means of collision avoidance; and the lack of automated redundancy in the air traffic control system to provide conflict detection between participating and nonparticipating aircraft. Author

N88-22878# National Transportation Safety Board, Washington, D. C. Bureau of Accident Investigation.
AIRCRAFT ACCIDENT/INCIDENT SUMMARY REPORTS: MODENA, PENNSYLVANIA, MARCH 17, 1986; REDWATER, TEXAS, APRIL 4, 1986
20 Mar. 1988 19 p
(PB88-910403; NTSB-AAR-88-01-Summ) Avail: NTIS HC A03/MF A01 CSCL 09C

This publication is a compilation of the reports of two separate aircraft accidents investigated by the National Transportation Safety Board. The accident locations and their dates are as follows: Modena, Pennsylvania, March 17, 1986, and Redwater, Texas, April 4, 1986. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N88-22879# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Hochfrequenz-Verfahren.
SECURING THE TIMESCALE OF THE NAVEX-REFERENCE CLOCK AND RATE DETERMINATIONS BY TIME COMPARISONS WITH THE HELP OF THE GLOBAL POSITIONING SYSTEM (GPS)
Helmut Nau Sep. 1987 67 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1111)
(DFVLR-Mitt-87-20; ISSN-0176-7739; ETN-88-92312) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 22.50 DM

It is shown that the method of time comparison by GPS is a powerful tool. Experimental results of time comparisons between UTC and an atomic clock are presented. The difference with the method of clock transportations is shown by four examples. The results of syntonization between the reference clock and a clock at Cape Canaveral are summarized. ESA

N88-22880# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Hochfrequenz-Verfahren.
NAVIGATION EXPERIMENT NAVEX. THE READING DIFFERENCES BETWEEN ALL GROUND STATION MEASURING CLOCKS DURING EACH SPACELAB PASS OF THE D1 MISSION
Herbert Schild Oct. 1987 40 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1113)
(DFVLR-Mitt-87-23; ISSN-0176-7739; ETN-88-92315) Avail: NTIS HC A03/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 14.40 DM

The reading differences between the measuring clock of the NAVEX master ground station and the measuring clocks of the receiving stations are calculated for each pass of the Space Shuttle. The reading rates between all clocks participating in the NAVEX experiment are given. It is possible to connect the readings of all clocks with each other in each second, i.e., the sequence of measurement. ESA

N88-22881# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Hamburg (West Germany). Abteilung Luft- und Raumfahrtpsychologie.
THE PROGRAM KENNEDY APPROACH AS AN EXPERIMENTAL DESIGN OF A DYNAMIC COMPUTERIZED AIR TRAFFIC CONTROL TEST
Klaus-Martin Goeters Dec. 1987 51 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-50; ISSN-0171-1342; ETN-88-92322) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 17.50 DM

The computer video game Kennedy Approach was applied as an experimental test during the psychological selection of applicants for air traffic control (ATC). The psychometric qualities as a measuring instrument as well as the correlational structure concerning different areas of the psychological evaluation (construct validity) were analyzed. The influence of experience with video games was determined. The results show that Kennedy Approach is a reasonable base for the development of a dynamic computer controlled ATC test. Proposals for test improvements are discussed. ESA

N88-22882# Ohio State Univ., Columbus. Engineering Experiment Station.
GLOBAL POSITIONING SYSTEM (GPS) EXPLOITATION BY ODOT (OHIO DEPARTMENT OF TRANSPORTATION)
D. C. Merchant, M. A. Baraka, P. A. Jensen, and Z. Q. Wei Jun. 1987 138 p Sponsored by Federal Highway Administration, Columbus, Ohio and Ohio Dept. of Transportation, Columbus
(PB88-172796; FHWA/OH-87/010) Avail: NTIS HC A07/MF A01 CSCL 17G

A new Dept. of Defense system of navigation satellites called NAVSTAR is currently in limited operation for development purposes. Because of the accurate nature of the satellite's clock and the accurate knowledge of its position in orbit, geodetic surveyors are able to exploit the NAVSTAR satellites for determining accurate positions relative to existing primary horizontal control documents. The NAVSTAR satellites and associated support equipment when used in the positioning mode is termed the Global Positioning System (GPS). Using several GPS ground based receivers, the surveyor can measure the position of a survey point to accuracies of two parts per million after only about one hour of observation time. A series of recommendations are made for implementation of GPS within the ODOT. Author

N88-22883*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
DEVELOPMENT OF A MOBILE RESEARCH FLIGHT TEST SUPPORT CAPABILITY
Donald C. Rhea and Archie L. Moore May 1988 12 p Presented at the 4th Flight Test Conference, San Diego, Calif., 18-20

May 1988
(NASA TM-100428; H-1456; NAS 1.15:100428; AIAA-88-2087)
Avail: NTIS HC A03/MF A01 CSCL 14B

This paper presents the approach taken by the NASA Western Aeronautical Test Range (WATR) of the Ames Research Center to develop and utilize mobile systems to satisfy unique real-time research flight test requirements of research projects such as the advanced fighter technology integration (AFTI)F-16, YAV-8B Harrier, F-18 high-alpha research vehicle (HARV), XV-15, and the UH-60 Black Hawk. The approach taken is cost-effective, staff efficient, technologically current, and provides a safe and effective research flight test environment to support a highly complex set of real-time requirements including the areas of tracking and data acquisition, communications (audio and video) and real-time processing and display, postmission processing, and command uplink. The development of this capability has been in response to the need for rapid deployment at varied site locations with full real-time computations and display capability. This paper will discuss the requirements, implementation and growth plan for mobile systems development within the NASA Western Aeronautical Test Range. Author

N88-22884*# Kansas Univ. Center for Research, Inc., Lawrence. Flight Research Lab.
ANALYSIS OF A RANGE ESTIMATOR WHICH USES MLS ANGLE MEASUREMENTS Final Report
David R. Downing and Dennis Linse Jul. 1987 81 p
(Grant NAG1-490)
(NASA-CR-182896; NAS 1.26:182896; KU-FRL-671-1) Avail: NTIS HC A05/MF A01 CSCL 17G

A concept that uses the azimuth signal from a microwave landing system (MLS) combined with onboard airspeed and heading data to estimate the horizontal range to the runway threshold is investigated. The absolute range error is evaluated for trajectories typical of General Aviation (GA) and commercial airline operations (CAO). These include constant intercept angles for GA and CAO, and complex curved trajectories for CAO. It is found that range errors of 4000 to 6000 feet at the entry of MLS coverage which then reduce to 1000-foot errors at runway centerline intercept are possible for GA operations. For CAO, errors at entry into MLS coverage of 2000 feet which reduce to 300 feet at runway centerline interception are possible. Author

N88-22885# Electronics Research Lab., Adelaide (Australia).
ASSESSMENT OF THE DIFFERENTIAL TECHNIQUE FOR LAND NAVIGATION WITHIN 1000 km OF OMEGA AUSTRALIA
J. H. Silby Jul. 1987 40 p
(AD-A191036; ERL-0423-TM; DODA-AR-004-971) Avail: NTIS HC A03/MF A01 CSCL 17G

Navigation section of Radio Group, Electronics Research Laboratory was required to investigate the behavior of the Australian Omega transmissions within Australia. This paper reports the approach used to undertake this investigation at points within the area of modal interference and the results obtained. Conclusions are drawn on the efficacy of using the Omega Australia transmissions in the differential mode in the areas investigated and comment is made on the use of differential Omega for land navigation in Australia drawing also on the results of trials reported previously. GRA

N88-22886*# Alphatech, Inc., Burlington, Mass.
EXPANDED ENVELOPE CONCEPTS FOR AIRCRAFT CONTROL-ELEMENT FAILURE DETECTION AND IDENTIFICATION Final Report
Jerold L. Weiss and John Y. Hsu Jun. 1988 100 p
(Contract NAS1-18004)
(NASA-CR-181664; NAS 1.26:181664; TR-378) Avail: NTIS HC A05/MF A01 CSCL 17G

The purpose of this effort was to develop and demonstrate concepts for expanding the envelope of failure detection and isolation (FDI) algorithms for aircraft-path failures. An algorithm which uses analytic-redundancy in the form of aerodynamic force and moment balance equations was used. Because aircraft-path FDI uses analytical models, there is a tradeoff between accuracy and the ability to detect and isolate failures. For single flight condition operation, design and analysis methods are developed to deal with this robustness problem. When the departure from the single flight condition is significant, algorithm adaptation is necessary. Adaptation requirements for the residual generation portion of the FDI algorithm are interpreted as the need for accurate, large-motion aero-models, over a broad range of velocity and altitude conditions. For the decision-making part of the algorithm, adaptation may require modifications to filtering operations, thresholds, and projection vectors that define the various hypothesis tests performed in the decision mechanism. Methods of obtaining and evaluating adequate residual generation and decision-making designs have been developed. The application of the residual generation ideas to a high-performance fighter is demonstrated by developing adaptive residuals for the AFTI-F-16 and simulating their behavior under a variety of maneuvers using the results of a NASA F-16 simulation. Author

N88-23286# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE INTEGRATION OF DIGITAL MAPS IN VEHICLE NAVIGATION SYSTEMS
Werner Lichtner *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 83-92 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation*.

N88-22887# National Aerospace Lab., Amsterdam (Netherlands).
DEVELOPMENT OF A FLEXIBLE AND ECONOMIC HELICOPTER ENGINE MONITORING SYSTEM
A. A. tenHave and C. R. Tjalsma 23 Jul. 1986 16 p Presented at the 12th European Rotocraft Forum, Garmisch-Partenkirchen, Fed. Republic of Germany, 22-25 Sep. 1986
(PB88-165147; NLR-MP-86046-U) Avail: NTIS HC A03/MF A01 CSCL 01C

In terms of fatigue life consumption the Royal Netherlands Navy (RNLN) is by now one of the leading operators of the Westland Lynx helicopter. Consequently, the RNLN feels a growing need to gain more insight into the Lynx fatigue loading environment. The topic of Lynx engine loading is the subject of a RNLN funded NLR research program aimed at investigating the possibility of continuous and automated monitoring of engine fatigue damage accumulation based on the Rolls-Royce Cyclic Lide Control concept. A pilot flight test program was performed, the results of which are being used for the development of a usable Lynx engine inflight data processor. Such a device will provide valuable information on the RLNL Lynx engine service loading and may be the basis of computerized Cyclic Life Control within the RNLN in the future. The major topics of the program are generally described. GRA

N88-22888# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
DESIGN STUDIES OF PRIMARY AIRCRAFT STRUCTURES IN ARALL LAMINATES
J. W. Gunnink Jun. 1987 32 p Presented at the ICCM 6/ECCM 2 Meeting, London, United Kingdom, 20-24 Jul. 1987
(LR-520; B8733286; ETN-88-92463) Avail: NTIS HC A03/MF A01

Use of ARALL for fatigue dominated structural parts, like the lower wing and the pressure cabin of an aircraft, was assessed.

To investigate the potential of the material, preliminary design studies were carried out on these components. The studies result in a weight reduction of more than 25 percent for the lower wing and the pressure cabin. ESA

N88-22889# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
THE INITIAL CALCULATION OF RANGE AND MISSION FUEL DURING CONCEPTUAL DESIGN
E. Torenbeek Aug. 1987 27 p
(LR-525; B8733276; ETN-88-92466) Avail: NTIS HC A03/MF A01

Derivations for the range of aircraft with gas turbine propulsion systems, which cannot be characterized to have either constant specific fuel consumption or constant propulsion efficiency are presented. The effects of different cruise techniques are investigated. It is found that for preliminary design purposes a very simple approximation of the fuel fraction can be used for all aircraft categories and various cruise techniques. This result was used to compute the total mission and reserve fuel. A method to derive the range parameter, eta L/D, for existing aircraft from their payload vs. range diagram is proposed. Such statistical data of the range parameter may be used as input for the calculation of the fuel fraction. The method is intended for use during conceptual design studies for a first estimation of the takeoff weight. ESA

N88-22890# European Space Agency, Paris (France).
DIGITAL PROCESSING OF FLIGHT DATA OF A HELICOPTER WITHOUT USING ANTI-ALIASING FILTERS
Rainer Holland (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, West Germany) Mar. 1988 57 p Transl. into ENGLISH of Digitale Verarbeitung von Flugversuchsdaten ohne Verwendung von Anti-Aliasing-Filtern am Beispiel eines Hubschraubers (Brunswick, Fed. Republic of Germany, DFVLR), Jun. 1987 54 p Original language document was announced as N88-14981
(ESA-TT-1094; DFVLR-Mitt-87-12; ETN-88-92562) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 22.50 DM

The possibility of sampling helicopter flight test data directly without prior artificial band limiting was studied. Data are filtered in the digital computer, after sampling. The results are compared with the measurement data obtained from analog filters before sampling. The decisive advantage of digital filtering is apparent. This occurs as a program in a computer where the frequency characteristics can be rapidly changed by changing numerical values. Analog filters require an elaborate technical implementation and space for the mechanical construction. A smaller and more compact measuring system could be achieved if anti-aliasing filters are not used. The recording of unfiltered measurement values provides additional information on possible signal distortion. The frequency characteristics of the digital filter can be varied within defined limits (aliasing) after the flight test. The greater data quantity in the case of the unfiltered sampling is a disadvantage which, however, is no longer significant with the use of larger storage media. However, the high computing time can be a disadvantage if use under real-time conditions is necessary. ESA

N88-22891*# Van der Velden (Alexander J. M.), Berkeley, Calif.
CONCEPTUAL FINAL PAPER ON THE PRELIMINARY DESIGN OF AN OBLIQUE FLYING WING SST Final Report
Alexander J. M. VanderVelden 6 Dec. 1987 33 p
(Grant NAG2-471)
(NASA-CR-182879; NAS 1.26:182879) Avail: NTIS HC A03/MF A01 CSCL 01C

A conceptual Oblique Flying Wing Supersonic Transport Aircraft (OFW, or surfplane because of its shape) was first proposed in 1957. It was reintroduced in 1987 in view of the emerging technology of artificial stabilization. This paper is based on the performance and economics study of an M2 B747-100B replacement aircraft. In order to make a fair comparison of this configuration with the B747, an end-sixties structural technology level is assumed. It is shown that a modern stability and control system can balance the aircraft and smooth out gusts, and that the OFW configuration equals or outperforms the B747 in speed, economy and comfort. Author

N88-22892*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MINIMUM WEIGHT DESIGN OF ROTORCRAFT BLADES WITH MULTIPLE FREQUENCY AND STRESS CONSTRAINTS
Aditi Chattopadhyay (Analytical Services and Materials, Inc., Hampton, Va.) and Joanne L. Walsh Mar. 1988 15 p Presented at the AIAA/ASME/ASCE/AHS 29th Structures, Structural Dynamics and Materials Conference, Williamsburg, Va., 18-20 Apr. 1988
(NASA-TM-100599; NAS 1.15:100569) Avail: NTIS HC A03/MF A01 CSCL 01C

Minimum weight designs of helicopter rotor blades with constraints on multiple coupled flap-lag natural frequencies are studied. Constraints are imposed on the minimum value of the blade autorotational inertia to ensure sufficient rotary inertia to autorotate in case of engine failure and on stresses to guard against structural failure due to blade centrifugal forces. Design variables include blade taper ratio, dimensions of the box beam located inside the airfoil and magnitudes of nonstructural weights. The program CAMRAD is used for the blade modal analysis; the program CONMIN is used for the optimization. A linear approximation involving Taylor series expansion is used to reduce the analysis effort. The procedure contains a sensitivity analysis consisting of analytical derivatives for objective function and constraints on autorotational inertia and stresses. Central finite difference derivatives are used for frequency constraints. Optimal designs are obtained for both rectangular and tapered blades. Using this method, it is possible to design a rotor blade with reduced weight, when compared to a baseline blade, while satisfying all the imposed design requirements. Author

N88-22893*# General Dynamics Corp., Fort Worth, Tex.
PARAMETRIC STUDY OF SUPERSONIC STOVL FLIGHT CHARACTERISTICS
David C. Rapp Mar. 1985 245 p
(Contract NAS2-11753)
(NASA-CR-177330; NAS 1.26:177330) Avail: NTIS HC A11/MF A01 CSCL 01C

A number of different control devices and techniques are evaluated to determine their suitability for increasing the short takeoff performance of a supersonic short-takeoff/vertical landing (STOVL) aircraft. Analysis was based on a rigid-body mathematical model of the General Dynamics E-7, a single engine configuration that utilizes ejectors and thrust deflection for propulsive lift. Alternatives investigated include increased static pitch, the addition of a close-coupled canard, use of boundary layer control to increase the takeoff lift coefficient, and the addition of a vectorable aft fan air nozzle. Other performance studies included the impact of individual E-7 features, the sensitivity to ejector performance, the effect of removing the afterburners, and a determination of optional takeoff and landing transition methods. The results pertain to both the E-7 and other configurations. Several alternatives were not as well suited to the E-7 characteristics as they would be to an alternative configuration, and vice versa. A large amount of supporting data for each analysis is included. Author

N88-22894# National Aeronautical Establishment, Ottawa (Ontario).
THE APPLICATION OF LINEAR MAXIMUM LIKELIHOOD ESTIMATION OF AERODYNAMIC DERIVATIVES FOR THE BELL-205 AND BELL-206
J. H. DeLeeuw and K. Hui Oct. 1987 60 p
(AD-A191279; NAE-AN-48; NRC-28442) Avail: NTIS HC A04/MF A01 CSCL 01A

Parameter identification from flight test data of fixed-wing aircraft is currently a common procedure for application to aircraft development work, validation of simulation, flight simulator

verification, flight control systems synthesis, aircraft handling qualities, flight envelope expansion and airplane certification. Similar work on the identification of the more complex helicopter system is currently still in the research stage. This report describes a number of flight test experiments involving the application of parameter estimation techniques to helicopters in order to determine the stability and control derivatives and to obtain information to identify improvements in the structure of the helicopter model. GRA

N88-22895# Army Aviation Engineering Flight Activity, Edwards AFB, Calif.
AIRWORTHINESS AND FLIGHT CHARACTERISTICS TEST OF A SKI ASSEMBLY FOR THE UH-60A BLACK HAWK HELICOPTER Final Report, for 30 Apr. 1987
Randall W. Cason, John I. Nagata, Thomas L. Reynolds, and Daumants Belte Aug. 1987 127 p
(AD-A191414) Avail: NTIS HC A07/MF A01 CSCL 01C

An Airworthiness and Flight Characteristics test of the UH-60A helicopter (S/N 84-23953) configured with a ski assembly was conducted by the U.S. Army Aviation Engineering Flight Activity. The test was conducted at the Sikorsky Flight Test Facility at West Palm Beach, Florida (elevation 28 feet). A total of 25.5 productive flight hours were flown during the period 6 to 30 April, 1987. Tests were conducted to determine the handling qualities and performance decrement of the ski assembly on the UH-60A helicopter at average mission gross weights of approximately 16,000 and 22,000 pounds. The handling qualities of the UH-60A with the ski assembly installed were essentially unchanged from those previously reported for the normal utility UH-60A. Two previously reported shortcomings are still evident: neutral static longitudinal stability during intermediate rated power climbs, and self-excited aircraft pitch oscillation with the collective control raised sufficiently for the aircraft to be light on its wheels. The equivalent flat plate area of the ski assembly was determined to be three sq ft. GRA

N88-23031# Joint Publications Research Service, Arlington, Va.
AIRCRAFT FLIGHT DYNAMICS RESEARCH IN PAST DECADE REVIEWED
Liqin Fan and Qishun Chen *In its* JPRS Report: Science and Technology. China 3 May 1988 p 1-8 Transl. into ENGLISH from Guoji Hangkong (Beijing, People's Republic of China), no. 2, Feb. 1988 p 28-31 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

N88-23129# Tracor Hydronautics, Inc., Laurel, Md.
AN EXPERIMENTAL STUDY TO DETERMINE THE FLOW AND THE SUBSONIC STATIC AND DYNAMIC STABILITY CHARACTERISTICS OF AIRCRAFT OPERATING AT HIGH ANGLES-OF-ATTACK
Alex Goodman and Clinton E. Brown *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 28 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-22896# National Aerospace Lab., Tokyo (Japan).
FIRST FLIGHT SIMULATOR TEST OF THE HEAD-UP DISPLAY FOR NAL QSTOL EXPERIMENTAL AIRCRAFT (ASUKA)
Keiji Tanaka, Kenji Yazawa, and Toshiharu Inagaki Oct. 1986 36 p In JAPANESE; ENGLISH summary
(DE88-751804; NAL-TM-554) Avail: NTIS (US Sales Only) HC A03

The following evaluation and information were obtained after the approach and landing simulation of Head-up Display HUD: (1) Velocity-Vector (VV) mode: effective for actual landing; easily controllable; landing accuracy is improved, (2) Pseudo-landing mode: effective for actual landing, but visibility of an actual runway deteriorates when the mock runway and the actual one overlap; pseudo-flare and touchdown are not exact; concerning pseudo-landing in the air, effective landing becomes possible, (3) CTOL landing: since the cross-checking load is alleviated and the flight path is accurately controlled, accurate approach becomes possible; Trim vector is effective for controlling speed and attitude and anticipatory control of power becomes feasible through speed vector, (4) STOL landing: when the stability control augmentation system (SCAS) is off, difficulty of lateral control is induced and control load is enhanced. DOE

N88-22897# National Aerospace Lab., Tokyo (Japan).
BASIC DESIGN OF A FLIGHT DIRECTOR SYSTEM FOR NAL STOL RESEARCH AIRCRAFT
Keiji Tanaka Dec. 1986 26 p In JAPANESE; ENGLISH summary
(DE88-751806; NAL-TM-558) Avail: NTIS (US Sales Only) HC A03

A basic design concept of a flight director system (FDS) is developed in an effort to examine backside operations during the approach phase, centering on the transient responses at the time of the shift to the ILS step and the stability during the following steps. This FDS has three commands: pitch command, flight path command, and bank command. Equations are formulated to generate these commands. To determine the flight-director dynamics, models of pilots, FDS and STOL research aircraft are developed on the assumption that they can be connected linearly, and dynamic responses of the entire system are calculated. To set up parameters based on responses of the system, examination is made of a stabilization/control system model, pilot model for pitch control, wash-out time constant of the pitch command loop, pilot model for speed control, glide slope capture characteristics, localizer deviation correction characteristics, and localizer capture characteristics. DOE

N88-22898# Aeritalia S.p.A., Turin (Italy). Gruppo Sistemi Avionics ed Equipaggiamenti.
RAPID PROTOTYPING OF COMPLEX AVIONICS SYSTEM ARCHITECTURES
L. Berardi, N. Giorgi, W. Mellano, A. Valante, and E. Zucco 1987 12 p
(ETN-88-92275) Avail: NTIS HC A03/MF A01

The Expert Consultant for Avionics System Transformation Exploitation was developed for rapidly prototyping different alternatives, and to establish the information flow architecture of the avionics system. The tool provides the user with an interface to assist in describing the avionics from the point of view of the data handling, and presents the results in a suitable format; it performs consistency checks and advises the user on possible architectural problems by means of the expert system techniques. The development environment of the tool and how it works in a consulting session are described. ESA

N88-22899# Strathclyde Univ., Glasgow (Scotland).
THE USE OF RULE INDUCTION TO ASSIST IN THE DIAGNOSIS OF AVIONIC CIRCUIT BOARD DEFECTS M.S. Thesis
G. B. Sadler 1987 81 p
(ETN-88-92077) Avail: NTIS HC A05/MF A01

An expert system to assist in the diagnosis of avionic circuit board faults was developed using the rule induction package Intelligence-1. The initial attempt at building an expert system failed but when the level of detail of attributes was altered an expert system was successfully built. The method was proved by building an expert system for a second circuit board using the same approach and by reproducing the same rules for the first board using a different rule induction package, IRIS. The expert system built for the first board was evaluated for accuracy by interrogation

using data from additional historical examples and for worth by monitored trials. The former show that the expert system is accurate but not complete and the latter is inconclusive. ESA

N88-22900# VDO-Luftfahrtgeraete Werk Adolf Schindling G.m.b.H., Frankfurt (West Germany).
BASIC DESIGN STUDIES FOR THE REALIZATION OF LIQUID CRYSTAL DISPLAY SYSTEMS IN AIRCRAFT Final Report, Sep. 1986
Hans Werner Fischer Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Feb. 1987 75 p In GERMAN; ENGLISH summary
(Contract BMFT-LFL-8376-0)
(VA-87-001; ETN-88-92094) Avail: NTIS HC A04/MF A01

A project to make liquid crystal technology available for displays and display systems in the cockpit of aircraft is discussed. This requires technological studies to select the most suitable type of liquid crystal. Specifications regarding contrast and readability for day and night operation have to be met. Corresponding to the actual applications, compromise solutions have to be found by optimization in order to meet additional, partly contrary, demands on the displays. The study of conditions for realizing a complete display system is given priority. It is to represent monitoring data of engines and auxiliary systems as well as warning signals in a helicopter. The design of the displays includes the display case and electronic control allowing for error recognition and reliability. Special difficulties result from requirements for lower weight and low power input. ESA

N88-22901*# Lockheed-Georgia Co., Marietta.
ANALYTICAL SENSOR REDUNDANCY ASSESSMENT Final Report
D. B. Mulcare, L. E. Downing, and M. K. Smith Apr. 1988 44 p
(Contract NAS2-11853)
(NASA-CR-182892; NAS 1.26:182892; DOT/FAA/CT-86/32)
Avail: NTIS HC A03/MF A01 CSCL 01D

The rationale and mechanization of sensor fault tolerance based on analytical redundancy principles are described. The concept involves the substitution of software procedures, such as an observer algorithm, to supplant additional hardware components. The observer synthesizes values of sensor states in lieu of their direct measurement. Such information can then be used, for example, to determine which of two disagreeing sensors is more correct, thus enhancing sensor fault survivability. Here a stability augmentation system is used as an example application, with required modifications being made to a quadruplex digital flight control system. The impact on software structure and the resultant revalidation effort are illustrated as well. Also, the use of an observer algorithm for wind gust filtering of the angle-of-attack sensor signal is presented. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-22902*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA ADVANCED TURBOPROP RESEARCH AND CONCEPT VALIDATION PROGRAM
John B. Whitlow, Jr. and G. Keith Sievers 1988 23 p Proposed for presentation at the 1988 Conference and Exposition on Future Transportation Technology, San Francisco, Calif., 8-11 Aug. 1988; sponsored by the Society of Automotive Engineers
(NASA-TM-100891; E-4129; NAS 1.15:100891) Avail: NTIS HC A03/MF A01 CSCL 21E

NASA has determined by experimental and analytical effort that use of advanced turboprop propulsion instead of the conventional turbofans in the older narrow-body airline fleet could reduce fuel consumption for this type of aircraft by up to 50 percent. In cooperation with industry, NASA has defined and implemented an Advanced Turboprop (ATP) program to develop and validate the technology required for these new high-speed, multibladed, thin, swept propeller concepts. This paper presents an overview of the analysis, model-scale test, and large-scale flight test elements of the program together with preliminary test results, as available. Author

N88-23247*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
AEROELASTIC FORCED RESPONSE ANALYSIS OF TURBOMACHINERY
Todd E. Smith (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 287-297 (For primary document see N88-23226 16-39)
(Contract NAS3-24105)
Avail: NTIS HC A20/MF A01 CSCL 21E

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-22903# European Space Agency, Paris (France).
SERVO-ACTUATOR CONTROL FOR SAMPLED-DATA FEEDBACK DISTURBANCE REJECTION
Josef Petry (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) Nov. 1987 221 p Transl. into ENGLISH of Zur Ansteuerung von Servoaktuatoren fuer die Stoergroessenkompensation mittels Abtastsystemen (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Jan. 1986 199 p Original language document was announced as N88-32446
(ESA-TT-1002; DFVLR-FB-86-06; ETN-88-91974) Avail: NTIS HC A10/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 57.50 DM

Based on a helicopter it is demonstrated why discrete feedback control for disturbance rejection using a pulse-amplitude-modulated control signal can cause undesired disturbing effects. This analysis is done in the frequency domain by frequency, and by spectral decompositions of the signals concerned. The results provide recommendations for a controller design. A continuous minor-loop feedback control which allows the continuous plant to be appropriately adjusted to the characteristics of discrete disturbance rejection is proposed. The efficiency of this approach is confirmed by design examples and simulations. ESA

N88-22904*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
ANALYSIS AND DESIGN OF GAIN SCHEDULED CONTROL SYSTEMS Ph.D. Thesis
Jeff S. Shamma May 1988 203 p
(Grant NAG2-297)
(NASA-CR-182867; NAS 1.26:182867; LIDS-TH-1770) Avail: NTIS HC A10/MF A01 CSCL 01C

Gain scheduling, as an idea, is to construct a global feedback control system for a time varying and/or nonlinear plant from a collection of local time invariant designs. However in the absence of a sound analysis, these designs come with no guarantees on the robustness, performance, or even nominal stability of the overall gain schedule design. Such an analysis is presented for three types of gain scheduling situations: (1) a linear parameter varying plant scheduling on its exogenous parameters, (2) a nonlinear plant scheduling on a prescribed reference trajectory, and (3) a

nonlinear plant scheduling on the current plant output. Conditions are given which guarantee that the stability, robustness, and performance properties of the fixed operating point designs carry over to the global gain scheduled designs, such as the scheduling variable should vary slowly and capture the plants nonlinearities. Finally, an alternate design framework is proposed which removes the slowing varying restriction or gain scheduled systems. This framework addresses some fundamental feedback issues previously ignored in standard gain. Author

N88-22905*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN INVESTIGATION OF THE ABILITY TO RECOVER FROM TRANSIENTS FOLLOWING FAILURES FOR SINGLE-PILOT ROTORCRAFT
M. Hossein Mansur and Jeffery A. Schroeder May 1988 43 p (NASA-TM-100078; A-88113; USAAVSCOM-TM-88-A-001; NAS 1.15:100078) Avail: NTIS HC A03/MF A01 CSCL 01C

A moving-base simulation was conducted to investigate a pilot's ability to recover from transients following single-axis hard-over failures of the flight-control system. The investigation was performed in conjunction with a host simulation that examined the influence of control modes on a single pilot's ability to perform various mission elements under high-workload conditions. The NASA Ames large-amplitude-motion Vertical Motion Simulator (VMS) was utilized, and the experimental variables were the failure axis, the severity of the failure, and the airspeed at which the failure occurred. Other factors, such as pilot workload and terrain and obstacle proximity at the time of failure, were kept as constant as possible within the framework of the host simulation task scenarios. No explicit failure warnings were presented to the pilot. Data from the experiment are shown, and pilot ratings are compared with the proposed handling-qualities requirements for military rotorcraft. Results indicate that the current proposed failure transient requirements may need revision. Author

N88-22906# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
STABILITY AND CONTROL METHODOLOGY FOR CONCEPTUAL AIRCRAFT DESIGN. VOLUME 1: METHODOLOGY MANUAL Final Report, Jun. 1985 - Jun. 1987
Terry S. Smith Dec. 1987 179 p
(AD-A191314; AFWAL-TR-87-3115-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 01A

This report contains methodology for predicting stability and control characteristics of conceptual flight vehicles. The methodology presented is a combination of existing methodology, modified existing methodology, and newly developed methodology. The methodology is divided into three main sections: (1) Aerodynamics of Longitudinal stability coefficients, (2) Lateral Stability coefficients, and (3) Static and Dynamic Stability Analysis. GRA

N88-23249*# Georgia Inst. of Tech., Atlanta.
APPLICATION OF NAVIER-STOKES ANALYSIS TO STALL FLUTTER
J. C. Wu, R. Srivastava, and L. N. Sankar *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 309-320 (For primary document see N88-23226 16-39)
(Grant NAG3-730)
Avail: NTIS HC A20/MF A01 CSCL 01A

N88-23250*# Toledo Univ., Ohio.
A COMPUTATIONAL PROCEDURE FOR AUTOMATED FLUTTER ANALYSIS
Durbha V. Murthy *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 323-336 Previously announced as N87-28058 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 01A

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-22907# Sandia National Labs., Albuquerque, N. Mex.
ULTRASONIC TIME-OF-FLIGHT DIFFRACTION (TOFD) MEASUREMENTS OF CRACK DEPTHS IN AN ACCELERATION RESERVOIR OF A HIGH VELOCITY RESEARCH GUN
J. H. Gieske 1988 17 p Presented at the 30th Meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO), Largo, Fla., 12 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-006644; SAND-88-0376C; CONF-880160-4) Avail: NTIS HC A03/MF A01

The Acceleration Reservoir (AR) of a two-stage light gas gun at Sandia's STAR - Shockwave Thermodynamic Applied Research - facility allows for the formation of shock fronts to propagate and accelerate projectiles with impact velocities up to 25,000 ft/second. The shock loading techniques are used by the Thermomechanical and Physical Division 1534 to study the properties of materials under extreme stress, stress rate, and temperature conditions. Because of the impact of a lead slurry-impregnated polyethylene piston at the tapered section of the AR, fatigue cracks develop and propagate in the bore area after each shot of the gun. Presently, the AR is taken out of service when the outer diameter of the AR increases by a given amount. In order to learn more about the actual damage present in a retired AR, the present study was undertaken. The reservoir investigated in this study was taken out of service after 103 shots. The ultrasonic pulse echo and Time-Of-Flight Diffraction (TOFD) techniques were employed in order to quantify the distribution of cracks along with their lengths and depths. The ultrasonic data will be used by division 1534 to investigate the nature of the fracturing process and perhaps model with a computer the dynamics of a crack subjected to pulse and shock loading. Hopefully, this information may then be used in the future to determine the proper retirement time of the reservoir. DOE

N88-22908# National Aerospace Lab., Tokyo (Japan).
DESIGN AND TEST OF A NEW COAXIAL AIR JOINTS
Osamu Nonaka, Teruomi Nakaya, Nobuhiro Toda, and Yoshio Hayashi Sep. 1986 23 p In JAPANESE; ENGLISH summary
(DE88-751808; NAL-TR-914) Avail: NTIS (US Sales Only) HC A03

In the recent frequent wind tunnel tests, higher measuring accuracy on the strength test is requested. By the use of air joint, accuracy was enhanced resulting in the wider workable range of output axial cylinder and easier fixing of the balance. A coaxial journal air joint with 3 freedom (translational) and 1 freedom (rotational) was test made and the amount of interference was measured. The interference could be reduced to less than 1.471 for the supply pressure, P = 1.373 MPa. Influence of load (with or without exhaust) on the interference was almost nil in this test. Problems left are the quenching of air vibration sound generated at the flange part at high pressure and the use of light ceramic material, for air joint, which is less subject to the gap variation between the floating axes due to the change in temperature or pressure. DOE

N88-22909# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Hauptabteilung Windkandele.
THE TRANSONIC WIND TUNNEL (TWB) AT DFVLR, BRUNSWICK (FEDERAL REPUBLIC OF GERMANY) Status Report, 1987
Wolfgang Puffert-Meissner Dec. 1987 47 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1114) Original contains color illustrations

(DFVLR-Mitt-88-01; ISSN-0176-7739; ETN-88-92317) Avail: NTIS HC A03/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 30.50 DM

The transonic wind tunnel Braunschweig is a pressurized blowdown windtunnel. The test section for two-dimensional airfoil testing has an area of 0.34 x 0.60 m. Mach number range is from 0.3 to 0.95 and Reynolds number range from 2,900,000 to 12 million at Mach 0.7, based on an airfoil chord length of 150 mm. Information required for the preliminary planning of test programs and for preliminary layout of models used in such programs is given. ESA

N88-22910# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Planetare Erkundung.

INFRARED SIMULATION MODEL SENSOR ATMOSPHERE TARGET (SENSAT)-2A

Rudolf Richter Dec. 1987 65 p

(DFVLR-FB-88-01; ISSN-0171-1342; ETN-88-92325) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 21.50 DM

A noise model for quantum detectors was added to model Sensor Atmophere Target-2. It accounts for the dependence of the detectivity on the background photon flux, the quantum efficiency, thermal detector noise, generation - recombination noise, 1/f noise, and preamplifier noise. A spectral band optimization module which calculates the infrared signature for a variable center wavelength and a variable bandwidth is introduced. The scene radiance and the signal-to-noise ratio are displayed in a 3-D plot. ESA

N88-22911*# National Aeronautics and Space Administration, Washington, D.C.

FLOW QUALITY OF NAL TWO-DIMENSIONAL TRANSONIC WIND TUNNEL. PART 1: MACH NUMBER DISTRIBUTIONS, FLOW ANGULARITIES AND PRELIMINARY STUDY OF SIDE WALL BOUNDARY LAYER SUCTION

Seizo Sakakibara, Kazuaki Takashima, Hitoshi Miwa, Yasuo Oguni, Mamoru Sato, and Hiroshi Kanda May 1988 96 p Transl. into ENGLISH of Japanese report (Tokyo, Japan, National Aerospace Lab.), 1982 p 1-79 Original language document was announced as N83-12043 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-4307)
(NASA-TT-20209; NAS 1.77:20209; NAL-TR-693) Avail: NTIS HC A05/MF A01 CSCL 14B

Experimental data on the flow quality of the National Aerospace Laboratory two-dimensional transonic wind tunnel are presented. Mach number distributions on the test section axis show good uniformity which is characterized by the two sigma (standard deviation) values of 0.0003 to 0.001 for a range of Mach numbers from 0.4 to 1.0. Flow angularities, which were measured by using a wing model with a symmetrical cross section, remained within 0.04 deg for Mach numbers from 0.2 to 0.8. Side wall boundary layer suction was applied through a pair of porous plates. The variation of aerodynamic properties of the model due to the suction mass flow rate change is presented with a brief discussion. Two dimensionality of the flow over the wing span is expected to be improved by applying the appropriate suction rate, which depends on the Mach number, Reynolds number, and lift coefficient. Author

N88-22912# Universal Energy Systems, Inc., Dayton, Ohio.

SOFT-GROUND AIRCRAFT ARRESTING SYSTEMS Final Report, Sep. 1986 - Aug. 1987

Robert F. Cook Aug. 1987 142 p

(Contract F33615-86-D-3800)
(AD-A190838; DOT/FAA/PM-87/27) Avail: NTIS HC A07/MF A01 CSCL 01E

The soft-ground aircraft arresting system study was initiated to determine whether or not aircraft having gross weight of 114,000 pounds to 630,000 pounds could be safely stopped after overrunning the available length of runway. The extended length of runway was limited to 1000 feet and the maximum velocity of the overrunning aircraft was selected to be 70 knots. The system was to be completely passive, have a long life, and easily repaired and maintained. Several arrestor materials such as clay, sand, gravel, water, an plastic foam were considered. An aircraft wheel/arrestor material model was developed and incorporated into a computer program FITER which allowed the determination of the aircraft stopping distance, landing gear loads, dynamic response, and rut depth in the arrestor material. Analyses conducted showed that sand, clay and water systems were not suitable arresting materials. Aircraft arrestment simulations were conducted for gravel and plastic foam arrestors and it was found that all aircraft could be safely stopped in less than 1000 feet. Evaluation of the stopping distance in an arrestor bed with the stopping distance of an extended runway was made and it was found that the arrestor system was needed to assure the safe stopping of an aircraft. GRA

N88-23126*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WATER FACILITIES IN RETROSPECT AND PROSPECT: AN ILLUMINATING TOOL FOR VEHICLE DESIGN

Gary E. Erickson, David J. Peake, John DelFrate, Andrew M. Skow, and Gerald N. Malcolm (Eidetics International, Inc., Torrance, Calif.) *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 28 p Previously announced as N87-13403 (For primary document see N88-23125 16-34)

Avail: NTIS HC A20/MF A01 CSCL 14B

N88-23128# Societe Bertin et Cie, Plaisir (France).

QUALIFICATION OF A WATER TUNNEL FOR FORCE MEASUREMENTS ON AERONAUTICAL MODELS [QUALIFICATION DUN TUNNEL HYDRODYNAMIQUE POUR DES PESEES DE MAQUETTES AERONAUTIQUES]

B. Chezlepretre and Y. Brocard *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 15 p In FRENCH; ENGLISH summary (For primary document see N88-23125 16-34)

Avail: NTIS HC A20/MF A01

N88-23132# National Research Council of Canada, Ottawa (Ontario). Low Speed Aerodynamics Lab.

THE USE OF THE NRC/NAE WATER FACILITIES IN CANADIAN AERONAUTICAL RESEARCH AND DEVELOPMENT

R. H. Wickens and N. E. Jeffreys *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 20 p (For primary document see N88-23125 16-34)

Avail: NTIS HC A20/MF A01

N88-23133# MATRA Service Aerodynamique, Velizy-Villacoublay (France).

DESCRIPTION OF A WATER TANK FACILITY: STUDY OF A MISSILE AT HIGH INCIDENCE [PRESENTATION DUN BASSIN HYDRODYNAMIQUE: ETUDE DUN MISSILE AUX GRANDES INCIDENCES]

J. Perinelle and A. Lupieri *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 20 p In FRENCH; ENGLISH summary (For primary document see N88-23125 16-34)

Avail: NTIS HC A20/MF A01

N88-23150# Stuttgart Univ. (West Germany). Inst. fuer Aerodynamik und Gasdynamik.

A NEW LAMINAR WATER TUNNEL TO STUDY THE TRANSITION PROCESS IN A BLASIUS LAYER AND IN A SEPARATION BUBBLE AND A NEW TOOL FOR INDUSTRIAL AERODYNAMICS AND HYDRODYNAMIC RESEARCH

M. Strunz and J. F. Speth *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 5 p (For primary document see N88-23125 16-34)

Avail: NTIS HC A20/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-22913# European Space Agency, Paris (France).
THE NAVEX EXPERIMENT IN THE SPACELAB D1 MISSION: PLANNING AND EXECUTION
Siegfried Starker, Hartmut Nau, and Jens Hammesfahr (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) Mar. 1988 143 p Transl. into ENGLISH of Das Experiment NAVEX bei der Spacelab-Mission D1 - Planung und Durchfuehrung (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Nov. 1986 120 p Original language document was announced in N88-10056
(ESA-TT-1078; DFVLR-FB-87-03; ETN-88-92560) Avail: NTIS HC A07/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany DM

The conception and the arrangement of the navigation experiment NAVEX, as well as the preparations and operations during the German Spacelab mission D1 are described. The main purpose of NAVEX was the realization and testing of techniques for the functions of future satellites and ground stations in navigation and timing systems using precise frequency standards. Mathematical descriptions of the experiments are explained. The data acquisition and processing systems are outlined. Results show that the techniques are successful, and that the measuring methods are well suited for timing systems. ESA

N88-22914*# National Aeronautics and Space Administration, Washington, D.C.
INTERNATIONAL MANNED FLIGHT, USSR-SAR
Jun. 1988 111 p Transl. into ENGLISH of Pilotiruyemyy Mezhdunarodnyy Polyot, SSSR-SAR (USSR), 1987 p 1-111 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20260; NAS 1.77:20260) Avail: NTIS HC A06/MF A01 CSCL 22A

Manned international space flights of the USSR and Syria are described. Data on the Proton and the Soyuz launch vehicles, and descriptions of the operations in the control rooms and training of control personnel are given. Cosmonaut training is discussed, as well as brief biographical data on the cosmonauts. Medical monitoring and medical support during spaceflights is also discussed. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N88-22915# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYTICAL ORBIT PROPAGATION OF ARTIFICIAL SATELLITES M.S. Thesis [PROPAGACAO ANALITICA DE ORBITAS DE SATELITES ARTIFICIAIS]
Sergio Mauri Fabri Dec. 1987 82 p In PORTUGUESE; ENGLISH summary
(INPE-4454-TDL/315) Avail: NTIS HC A05/MF A01

The purpose of this study was to derive a set of variables with which to solve the problem of singularities in the usual analysis of satellite orbit propagation. Through a rearrangement of Brouwer expressions, a new set of variables is obtained. These variables allow transformations of oscillating elements to mean elements and vice versa. The mean elements are analytically propagated considering the geopotential perturbations (zonals, up to J sub 5). The method is also used to furnish mean elements for other analytical procedures for orbit propagation. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-22916# Sandia National Labs., Albuquerque, N. Mex.
RAILGUN RAIL GOUGING BY HYPERVELOCITY SLIDING CONTACT
L. M. Barker, T. G. Trucano, and A. R. Susoeff 1988 10 p Presented at the 4th Symposium on Electromagnetic Launch Technology, Austin, Tex., 12 Apr. 1988 Prepared in cooperation with Lawrence Livermore National Lab., Calif.
(Contract DE-AC04-76DP-00789)
(DE88-006866; SAND-87-2299C; CONF-880478-2) Avail: NTIS HC A02/MF A01

A description is given of a recently resolved mechanism of gouging which occurs during hypervelocity sliding contact between two materials. A parameter study based on computer modelling of the gouging mechanism is presented in which gouging velocity thresholds are determined for several combinations of sliding materials. Materials which can gouge each other are found to do so only within a certain range of velocities. Related calculations of gaseous material ahead of railgun projectiles are also presented. Gun bore gouging experience with the Lawrence Livermore National Laboratory railgun project is reviewed. DOE

N88-22917# Institut fuer Rundfunktechnik, Munich (West Germany).
CONSTRUCTION OF A SATELLITE SIMULATOR FOR THE FREQUENCY RANGE BETWEEN 11.7 AND 12.5 GHz [BAU EINES SATELLITENSIMULATORS FUER DEN FREQUENZBEREICH 11,7 - 12,5 GHZ]
V. Rajic and C. Dosch 30 Mar. 1987 56 p In GERMAN
(IRT-TB-B-84/87; ETN-88-91468) Avail: NTIS HC A04/MF A01

A satellite simulator was built for testing receivers in the satellite radio broadcasting frequency range from 11.7 to 12.5 GHz, and the investigation of transmission methods under conditions close to reality. Possible linear and nonlinear signal distortions, and the requirements for simulator and transmission are discussed. The input and output frequencies are internally switchable between 70 and 118 MHz; any frequency can be obtained using an external local oscillator. The satellite output multiplexer OMUX is only correct for the German channel 14 (11.97 to 82 MHz), but an adjustment to any frequency in the range 11.7 to 12.5 GHz is possible. The simulator corresponds to a real satellite transmission concerning nonlinearities and linear distortions. ESA

N88-22918# Materials Research Labs., Ascot Vale (Australia).
EXPERIMENTAL INVESTIGATION OF A THREE-STAGE RAILGUN INCORPORATING PUFF-SWITCHING
D. R. Sadedin and D. F. Stainsby May 1987 72 p
(AD-A191044; MRL-R-1056; DODA-AR-005-135) Avail: NTIS HC A04/MF A01 CSCL 20C

A sequence of four firings of a 2.4 m long, 10 mm square bore railgun is described and analyzed. The railgun comprised an injection stage, a breech power source and second power source which was connected by a puff switch. The report deals with the puff-switching results, distribution of current in the plasma, the proportion of projectile kinetic energy due to plasma expansion forces as compared to electromagnetic forces, the correlation of rail damage with current and plasma length, and velocity limitation according to the ablation model. GRA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

No abstracts in this category.

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

No abstracts in this category.

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N88-22919*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NUMERICAL ARC SEGMENTATION ALGORITHM FOR A RADIO CONFERENCE: A SOFTWARE TOOL FOR COMMUNICATION SATELLITE SYSTEMS PLANNING

W. A. Whyte, A. O. Heyward, D. S. Ponchak, R. L. Spence, and J. E. Zuzek 1988 16 p Presented at the 12th International Communications Satellite Systems Conference, Arlington, Va., 13-17 Mar. 1988; sponsored by AIAA Previously announced in IAA as A88-27531

(NASA-TM-100789; E-3962; NAS 1.15:100789; AIAA-88-0788) Avail: NTIS HC A03/MF A01 CSCL 09F

The Numerical Arc Segmentation Algorithm for a Radio Conference (NASARC) provides a method of generating predetermined arc segments for use in the development of an allotment planning procedure to be carried out at the 1988 World Administrative Radio Conference (WARC) on the Use of the Geostationary Satellite Orbit and the Planning of Space Services Utilizing It. Through careful selection of the predetermined arc (PDA) for each administration, flexibility can be increased in terms of choice of system technical characteristics and specific orbit location while reducing the need for coordination among administrations. The NASARC software determines pairwise compatibility between all possible service areas at discrete arc locations. NASARC then exhaustively enumerates groups of administrations whose satellites can be closely located in orbit, and finds the arc segment over which each such compatible group exists. From the set of all possible compatible groupings, groups and their associated arc segments are selected using a heuristic procedure such that a PDA is identified for each administration. Various aspects of the NASARC concept and how the software accomplishes specific features of allotment planning are discussed. Author

N88-22920*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE BIT-ERROR RATE PERFORMANCE OF A SATELLITE MICROWAVE MATRIX SWITCH

Robert J. Kerczewski 1988 14 p Presented at the 12th International Communication Satellite Systems Conference, Arlington, Va., 13-17 Mar. 1988; sponsored by AIAA Previously announced in IAA as A88-27572

(NASA-TM-100285; E-3925; NAS 1.15:100285; AIAA-88-0826) Avail: NTIS HC A03/MF A01 CSCL 09F

The matrix switch is a critical element of communications satellites using multiple-beam antennas and on-board switching. Two proof-of-concept models of a microwave matrix switch have been developed under NASA-sponsored contracts. These switches have undergone extensive testing at NASA Lewis Research Center to determine their operating characteristics in a system environment. The results of these tests indicate the effect of the matrix switch on the overall system operation. Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-22921# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.

TETHERED DIAGNOSTIC PACKAGE FOR USE FROM THE SPACE STATION

J. D. Sullivan, R. S. Post, J. H. Irby, and E. C. Lorenzini 1987 10 p Presented at the 2nd International Conference on Tethers in Space, Venice, Italy, 6 Oct. 1987 Prepared in cooperation with Smithsonian Astrophysical Observatory, Cambridge, Mass.

(Contract DE-AC02-78ET-51013)

(DE88-006264; PFC/CP-87-22; CONF-8710207-1) Avail: NTIS HC A02/MF A01

The interaction in the upper ionosphere between the ambient medium and Space Station or other orbiting vehicles in the 1990s will require measurements from essentially nonintrusive instrumentation and the ability to repeat those measurements at will in an extended region about a space vehicle. A diagnostic package on a line, a Spin-Cast Diagnostic Package (SCDP), can complement free flyers and attached instrumentation in the region from 10 m to 1 Km. The basic concept for the SCDP is to cast off, probably electromagnetically, on a fiber optic line in some chosen direction a small, battery powdered, instrumentation package and then to reel it back in while making measurements. The SCDP instrumentation package could have interchangable sensors or transducers; a typical package might include pressure monitors, various plasma probes, magnetometers, plasma wave, and optical sensors which could include video imaging. The dynamics of the deployment and retrieval maneuvers of the SCDP is analyzed. Strategies for casting the package in any given direction from the Space Station are devised. Fast, impulsive retrieval maneuvers with negligible tension in the tether are also investigated. Author

N88-22922# Societe Nationale Industrielle Aerospatiale, Les Mureaux (France). Div. Systemes Strategiques et Spatiaux.

A PYROTECHNICAL OPENING VALVE Final Report [VANNE PYROTECHNIQUE A OUVERTURE]

B. Faro Paris, France ESA 14 Aug. 1987 72 p In FRENCH Original contains color illustrations

(Contract ESTEC-5788/84/NL-AN)

(SNIAS-MU/TYS-NT-2-06(0); ESA-CR(P)-2521; ETN-88-91957) Avail: NTIS HC A04/MF A01

The design and test of a pyrotechnical valve for space

applications are described. The specifications include a double wall to break, 6.4 mm dia, and a maximum breaking pressure of 1200 bar. After detonation the water flow loss should be less than 0.1 bar for 0.12 kg/sec at 20 bar inlet pressure. An explosive charge of 70 mg is used. ESA

N88-22923# Societe Nationale Industrielle Aerospatiale, Cannes (France). Div. Systemes Balistiques et Spatiaux.
NEW CONCEPTS FOR ATMOSPHERIC BRAKING DECELERATION IN PLANETARY ATMOSPHERE ENTRY Final Report [NOUVEAUX CONCEPTS DE SYSTEMES DE DECELERATION PAR FREINAGE ATMOSPHERIQUE POUR L ENTREE DANS DES ATMOSPHERES PLANETAIRES]
G. Taquin, A. Silbermann, and J. L. Marino Paris, France ESA 5 Sep. 1986 98 p In FRENCH Original contains color illustrations
(Contract ESTEC-6357/85/NL-PH(SC))
(SNIAS-CAS-DECE-P003-DPAA; ESA-CR(P)-2426-Vol-1; ETN-88-91964) Copyright Avail: NTIS HC A05/MF A01

The specifications studied correspond to the CASSINI ESA project designed to analyze the atmosphere of Titan. The aerothermodynamic analysis considers the deceleration of 192.3 kg from Mach 27 at 1000 km to Mach 1 at 175 km. Thermal and mechanical predesign of several devices were compared. The choice is a nondeployable semiconical rigid decelerator. The Lindal atmospheric model predicts for this case Mach 1 at 170 km with an estimated mass of 19 kg and a maximum estimated temperature of 1200 deg. The critical point is related to space aging for 7.7 years, is discussed. ESA

N88-22924# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
MAXIMUM LIKELIHOOD PARAMETER IDENTIFICATION OF FLEXIBLE SPACECRAFT
Qi Ping Chu Mar. 1987 264 p
(LR-508; B8733287; ETN-88-92456) Avail: NTIS HC A12/MF A01

Identifying parameters of a flexible spacecraft model from in-orbit measurements is discussed, emphasizing mathematical modelling of a flexible spacecraft, using finite element analysis, and maximum likelihood parameter estimation, based on system models of reduced order with correlated process and measurement noise. It is shown that finite element analysis can be used to develop mathematical models of finite order of three-dimensional flexible spacecraft in arbitrary orbits. The following parameters in the flexible spacecraft model may be estimated from dynamic response measurements: Young's elasticity modulus, the Poisson ratio, the inertia matrix of the rigid main body and the jet input amplitudes. ESA

N88-22925# Sandia National Labs., Albuquerque, N. Mex.
THE NONLINEAR DYNAMICS OF A SPACECRAFT COUPLED TO THE VIBRATION OF A CONTAINED FLUID
L. D. Peterson, E. F. Crawley, and R. J. Hansman 1988 38 p Presented at the 29th Structures Dynamics and Materials Conference, Williamsburg, Va., 18 Apr. 1988 Prepared in cooperation with MIT, Cambridge
(Contract DE-AC04-76DP-00789)
(DE88-007035; SAND-87-2200C; CONF-880483-1) Avail: NTIS HC A03/MF A01

The dynamics of a linear spacecraft mode coupled to the nonlinear low gravity slosh of a fluid in a cylindrical tank is investigated. Coupled, nonlinear equations of motion for the fluid-spacecraft dynamics are derived through an assumed mode Lagrangian method. Unlike linear fluid slosh models, this nonlinear slosh model retains two fundamental slosh modes and three secondary modes. An approximate perturbation solution of the equations of motion indicates that the nonlinear coupled system response involves fluid-spacecraft modal resonances not predicted by either a linear or a nonlinear, uncoupled slosh analysis. An experiment was developed to verify and compliment this analysis. Scale model fluid tanks were coupled to an electromechanical analog for the second order oscillatory spacecraft mode. Moderate and low gravity were investigated in 1-g using capillary scale models, and zero gravity was investigated on the NASA KC-135 Reduced Gravity Test Facility. The experimental results substantiate the analytical predictions. The dependence of the coupled nonlinear response on the coupled system parameters and the gravity level is illustrated and discussed. DOE

N88-22926# Naval Postgraduate School, Monterey, Calif.
SURVEY OF THE AIR FORCE P78-2 (SCATHA) SATELLITE PLASMA WAVE DATA DURING ELECTRON GUN OPERATIONS M.S. Thesis
Donald R. Lowery Dec. 1987 96 p
(AD-A191014) Avail: NTIS HC A05/MF A01 CSCL 22A

The Air Force P78-2 satellite, known as SCATHA, was designed to study spacecraft charging processes at geosynchronous orbit. This thesis examines the plasma wave data taken during two periods when active experiments were conducted with the electron gun. Emissions at the electron gyrofrequency were stimulated by the operation of the electron gun on some occasions. These indicate interaction between the electron beam and plasma at local resonant frequencies of the plasma. A major objective of this thesis is to catalogue the characteristics of the plasma wave data common to the modes of operation of the electron gun. The purpose is to provide a baseline for analysis of data not only from SCATHA, but from other spacecraft including the Space Shuttle Orbiter. Stimulated emissions at characteristic frequencies dependent on gun current and voltage were identified. These were consistently observed during the experiment presented here. GRA

N88-22927# Imperial Coll. of Science and Technology, London (England). Dept. of Chemical Engineering and Chemical Technology.
[LASER INDUCED IGNITION OF PROPELLANTS] Interim Report No. 2, 31 Jul. - 31 Dec. 1987
F. B. Carleton, F. J. Weinberg, and K. Krallis 31 Dec. 1987 5 p
(Contract DAJA45-87-C-0010)
(AD-A191100) Avail: NTIS HC A02/MF A01 CSCL 21B

As mentioned in the conclusion to the preceding research project, precursory electrolysis may profoundly affect ignition by any source, if solution in the propellant of gases liberated at the electrodes play a significant part in the process. Accordingly, it was decided to use the means of suspending propellant droplets in the beam simultaneously for the electrical initiation. Preliminary experiments on exploding droplets of propellants in this manner show similar dependence on electrical parameters as in previous work. There is a voltage threshold above which the event becomes very vigorous. When large droplets are used not all the liquid is decomposed and small satellite droplets are seen to be flung off. Work is in progress comparing the behavior of propellants in this system with aqueous solutions of salts which have similar electrical properties but are not capable of decomposing chemically. GRA

N88-22928# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.
VIBRATION CONTROL OF LARGE STRUCTURES Final Technical Report, 1 Jan. - 31 Dec. 1986
Anthony K. Amos Sep. 1987 33 p
(Contract F49620-86-K-0009)
(AD-A191358; UVA/525673/MAE88/101; AFOSR-88-0007TR)
Avail: NTIS HC A03/MF A01 CSCL 22A

This is a study of vibration control for large space structures. Advantage is taken of the limiting performance characteristics of dynamic systems. This approach permits large problems with constraints to be analyzed. A modal formulation for the limiting performance was developed in order to enhance the applicability of limiting performance to large structural systems. One effort to develop an optimal control system is based on the limiting performance approach in combination with classical/optimal control theory. A limiting-performance/minimum-time solution was formulated to achieve the goal of rapid suppression of disturbances. Classical/optimal control studies show that a position loop might

be useful in taking care of constraint controllers, such as proof-mass dampers. Finally, to derive feedback control law based on the limiting performance characteristics, parameter identification technique has been under investigation. GRA

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N88-22929# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DEVELOPMENT OF A DIGITAL SUN SENSOR FOR A SPIN-STABILIZED SATELLITE M.S. Thesis [DESENVOLVIMENTO DE UM SENSOR SOLAR DIGITAL PARA SATELITE ESTABILIZADO EM ROTACAO]
Marcos Antonio Bertolino Apr. 1988 156 p In PORTUGUESE; ENGLISH summary
(INPE-4508-TDL/327) Avail: NTIS HC A08/MF A01

Some general features related to sun sensor development for a spin stabilized satellite are presented. The sensor is of the digital type with a 7 bit gray code, angular resolution of 1 deg, with the code printed on the photodiode array. Consideration is given to equipment characteristics and components, transfer function modeling and test results, which prove the sensor operation is in agreement with predicted specifications. Emphasis is given to the error budget, in which an accuracy of 40 arc minutes is obtained, through addition of error components. Fabrication processes are analyzed, to ensure the feasibility of obtaining the required accuracy. This sensor will be used in the Data Collection Satellite of the Brazilian Complete Space Mission. Author

N88-22930# Panametrics, Inc., Waltham, Mass.
DESIGN, FABRICATE, CALIBRATE, TEST AND DELIVER TWO SATELLITE ELECTRON FLUX DETECTORS Final Report, 24 Sep. 1979 - 20 Aug. 1986
Jean L. Hunerwadel, Bach Sellers, and Frederick A. Hanser Jun. 1987 58 p
(Contract F19628-79-C-0175)
(AD-A190799; AFGL-TR-87-0205) Avail: NTIS HC A04/MF A01 CSCL 18D

A satellite borne High Energy Electron Analyzer has been designed to measure electrons in the range of 1 MeV to 10 MeV. Very low background from omnidirectional charged particles is achieved with two Solid State Detectors and a BGO scintillator crystal arranged in a telescope unit and with the requirement of a triple coincidence of electrons in the measurement range. Ten energy bins are provided by the BGO over this range. Additionally, electron singles above 10 MeV and proton singles above 15.7 MeV are measured by the BGO crystal. The Solid State Detectors also provide measurements for proton singles from 4.1 MeV to 269 MeV. The background is further reduced by a plastic scintillator, surrounding the BGO, and placed into anticoincidence with the electron measurement. A complete electron energy spectrum plus singles measurement is generated every .512 seconds. The higher count rates from 3.5 to 1000 kcps are accommodated with compression counters while the lower count rates are accumulated in straight ripple counters. Three different coincidence requirements (Front SSD coincidence, Back SSD coincidence, Shield anticoincidence) are selectable by ground command. Two instruments have been fabricated, tested and calibrated. The first of these has been integrated on the CRRES satellite and is currently undergoing spacecraft testing at BASD. GRA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-22931# Erno Raumfahrttechnik G.m.b.H., Bremen (West Germany).
DEVELOPMENT AND QUALIFICATION OF AN AUGMENTED ELECTRO-THERMAL HYDRAZINE-THRUSTER (AEHT) WITH 0.1 TO 0.2 N VACUUM THRUST Final Report, Jun. 1982
Manfred Steenborg Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 165 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany
(BMFT-FB-W-86-012; ISSN-0170-1339; ETN-88-92326)
Copyright Avail: NTIS HC A08/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany, 34.50 deutsche marks + MWST

The development of an augmented electrothermal hydrazine thruster (AEHT), including handling of such high temperature materials as molybdenum, molybdenum/rhenium, titanium circruia stabilized molybdenum, and rhenium is discussed. High temperature brazing and electron beam welding of samples of high temperature material; high temperature compatibility tests in connection with the decomposition products of hydrazine as NH3, N2, and H2 at 1600 C are summarized. Investigation of brazing and welding parameters; metallurgical investigation of samples joined by welding and high temperature brazing; machining of development thrusters and hot-firing tests; metallurgical investigation of thruster parts after hot-firing tests; machining of prototypes of EAHT; and testing heater elements to heat up the decomposer of the AEHT are described. The objective, developing and machining of a high-efficiency AEHT with an average specific impulse 3000 ns/kg, is achieved. The test duration of the AEHT was 23 hr. Performance of the AEHT after testing for over 300 hr cannot be assessed. Qualification of AEHT including hot-firing test for 150 hr is not achieved. ESA

N88-22932# Krupp (Fried.) G.m.b.H., Essen (West Germany).
DEVELOPMENT OF A SLIP-RING SYSTEM FOR ENERGY TRANSFER IN SPACE CONDITIONS. SPACE FLIGHT QUALIFICATION AND EXTENDED LIFE TESTS Final Report
Gebhard Tomalla and Dieter Neuschuetz Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 111 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany
(BMFT-FB-W-86-019; ISSN-0170-1339; ETN-88-92329)
Copyright Avail: NTIS HC A06/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 22.50 DM

A power slip-ring unit was subjected to space prequalification and expanded life tests. The vibration and the thermo-vacuum test are passed successfully. The ceramic insulators and the brush contacts survive the tests without any damage. During the life test, the slip-ring unit was run with 200 A (corresponding to a power transfer of 10 kW at an operating voltage of 50 V) less than 0.0000007 mbar over 35 days in a 0.3 deg step mode at 1 step/sec. The maximum friction torque amounted to 0.7 Nm, while the electrical power loss, including internal cabling, was 4.96 W, corresponding to a total electrical efficiency of 99.95 percent. The noise level has the extremely low value of less than 0.2 mV (rms)/A. ESA

N88-22933*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESCRIPTION OF AN OSCILLATING FLOW PRESSURE DROP TEST RIG

J. Gary Wood, Eric L. Miller, David R. Gedeon, and Gary E. Koester (Sunpower, Inc., Athens, Ohio.) [1988] 8 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored in part by ASME, AIAA, ANS, SAE, IEEE, ACS and AIChE

(NASA-TM-100905; E-4102; NAS 1.15:100905) Avail: NTIS HC A02/MF A01 CSCL 10B

A test rig designed to generate heat exchanger pressure drop information under oscillating flow conditions is described. This oscillating flow rig is based on a variable stroke and variable frequency linear drive motor. A frequency capability of 120 hertz and a mean test pressure up to 15 mPA (2200 psi) allows for testing at flow conditions found in modern high specific power Stirling engines. An important design feature of this rig is that it utilizes a single close coupled dynamic pressure transducer to measure the pressure drop across the test sample. This eliminates instrumentation difficulties associated with the pressure sensing lines common to differential pressure transducers. Another feature of the rig is that it utilizes a single displacement piston. This allows for testing of different sample lengths and configurations without hardware modifications. All data acquisition and reduction for the rig is performed with a dedicated personal computer. Thus the overall system design efficiently integrates the testing and data reduction procedures. The design methodology and details of the test rig is described. Author

N88-22934*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE 1988 OVERVIEW OF FREE-PISTON STIRLING TECHNOLOGY FOR SPACE POWER AT THE NASA LEWIS RESEARCH CENTER

Jack G. Slaby [1988] 11 p Prepared for presentation at the 4th International Conference on Stirling Engines, Tokyo, Japan, 7-10 Nov. 1988; sponsored by the Japan Society of Mechanical Engineers

(NASA-TM-100795; E-3971; NAS 1.15:100795) Avail: NTIS HC A03/MF A01 CSCL 10B

The completion of the Space Power Demonstrator Engine (SPDE) testing is discussed, terminating with the generation of 25 kW of engine power from a dynamically-balanced opposed-piston Stirling engine at a temperature ratio of 2.0. Engine efficiency was greater than 22 percent. The SPDE recently was divided into 2 separate single cylinder engines, Space Power Research Engine (SPRE), that serves as test beds for the evaluation of key technology disciplines, which include hydrodynamic gas bearings, high efficiency linear alternators, space qualified heat pipe heat exchangers, oscillating flow code validation, and engine loss understanding. The success of the SPDE at 650 K has resulted in a more ambitious Stirling endeavor, the design, fabrication, test, and evaluation of a designed-for-space 25 kW per cylinder Stirling Space Engine (SSE) to operate at a hot metal temperature of 1050 K using superalloy materials. This design is a low temperature confirmation of the 1300 K design. It is the 1300 K free-piston Stirling power conversion system that is the ultimate goal. The first two phases of this program, the 650 K SPDE and the 1050 K SSE are emphasized. Author

N88-22935*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN INTEGRATED AND MODULAR DIGITAL MODELING APPROACH FOR THE SPACE STATION ELECTRICAL POWER SYSTEM DEVELOPMENT

Frank J. Gombos (Rockwell International Corp., Canoga Park, Calif.) and Narayan Dravid [1988] 9 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored in part by ASME, AIAA, ANS, SAE, IEEE, ACS, and AIChE

(NASA-TM-100904; E-4155; NAS 1.15:100904) Avail: NTIS HC A02/MF A01 CSCL 10B

An electrical power system for the Space Station was designed, developed and built. This system provides for electrical power generation, conditioning, storage, and distribution. The initial configuration uses photovoltaic power generation. The power system control is based on a hierarchical architecture to support the requirements of automation. In the preliminary design and technology development phase of the program, various modeling techniques and software tools were evaluated for the purpose of meeting the Space Station power system modeling requirements. Rocketdyne and LeRC jointly selected the EASY5 simulation software, developed by Boeing Computer Services, as a system level modeling tool. The application of the selected analytical modeling approach to represent the entire power system is described. Typical results of model predictions are also summarized. The equipment modeled includes solar arrays, dc to ac converters, resonant inverters, battery storage system, alternator, transmission line, switch gear, and system level microprocessor controls. During the advanced development phase of this program, several models were developed using this approach. Author

N88-22936# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

COMBUSTION OF A DOUBLE BASE FUEL IN THE PRESENCE OF INERT GASES [COMBUSTAO DE UMA POLVORA DE BASE DUPLA EM PRESENCA DE GASES INERTES]

Fernando FachiniFilho, Carlos Eduardo SeraphicodeSouzaMigueis, Walter Gill, and Demetrio BastosNetto May 1988 16 p In PORTUGUESE; ENGLISH summary

(INPE-4516-RPE/564) Avail: NTIS HC A03/MF A01

Solid propellant rocket engines are simple and reliable; however, they have the disadvantage of permitting only directional control of the thrust. This work is a continuation of an ongoing effort to understand the mechanism of thrust level modulation using inert gas injection into the combustion chamber. Here, tests are done using combustion bombs, analyzing the effect of the presence of inert gases on the burning of a double base fuel. Author

N88-22937*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.

ADVANCED ELECTRIC PROPULSION RESEARCH Annual Report

Paul J. Wilbur Jan. 1988 109 p

(Grant NGR-06-002-112)

(NASA-CR-182130; NAS 1.26:182130) Avail: NTIS HC A06/MF A01 CSCL 21C

Results are presented which show that hollow cathodes can be operated on ammonia but that sustained operation in the high pressures where arcjet thrusters operate (of the order of 1000 Torr) is difficult to achieve. The concept of using contoured, fine wire meshes attached across the screen grid apertures in an ion thruster to effect control of the ion beam divergence is introduced. The concept is compared to conventional (free sheath) ion extraction and is shown to be potentially attractive. The performance related effects of changing the anode and cathode locations and of interchanging hollow cathode and refractory filament electron sources within an 8-cm diameter, argon, ring cusp ion thruster discharge chamber are examined. The effects induced in discharge chamber performance by changes in magnetic field strength and configuration and in propellant flow distribution are also measured. Results are presented in terms of changes in the parameters that describe the effectiveness of primary electron utilization and ion extraction into the beam. The apparatus and instrumentation used to study hollow cathode operation at high electron emission levels (of the order of 100 A) is described. Author

N88-22938# Oak Ridge National Lab., Tenn. Engineering Technology Div.

VALUE OF ENERGY STORAGE IN PULSED SPACE POWER SYSTEMS

M. Olszewski and D. G. Morris Jan. 1988 70 p

(Contracts DE-AC05-84OR-21400; MIPR-FY-1455-85-N0617)
(AD-A191311; ORNL/TM-10530) Avail: NTIS HC A04/MF A01 CSCL 22B

Due to the pulsed nature of burst power demands in spacebased SDI applications, energy storage can be used to effect reductions in overall power system mass and reduce area requirements for radiators. Incorporation of energy storage allows subsystems (i.e., radiator, power conversion cycle, etc.) to be sized for orbital average duty. Without storage these systems must be sized to meet peak demands. The value of energy storage was judged primarily by comparing the mass of power systems (or subsystems) with and without a storage component. The assessment of thermal energy storage (TES), using a packed bed of encapsulated LiH shapes, coupled with a radiator, indicated that TES is beneficial for generation times of up to 1700 s. Mass savings increase with decreasing total generation time. They are maximized when the TES unit operating mode allows heat rejection and storage to take place during sprint operation. Radiator area reductions are larger than the mass savings and accrue even when the storage component represents a mass penalty. Regenerable electrical storage (RES) and TES were examined in conjunction with nuclear Rankine, solar Brayton and Rankine, and thermionic concepts. Flywheels, fuel cells and batteries were found to be the RES technologies applicable to the storage mission. GRA

N88-22939*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE APPLICATION OF HIGH TEMPERATURE SUPERCONDUCTORS TO SPACE ELECTRICAL POWER DISTRIBUTION COMPONENTS
Paul R. Aron and Ira T. Myers 1988 8 p Proposed for presentation at the 23rd Intersociety Energy Conversion Engineering Conference, 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ACS and AIChE
(NASA-TM-100901; E-4153; NAS 1.15:100901) Avail: NTIS HC A02/MF A01 CSCL 10B

Some important space based electrical power distribution systems and components are examined to determine what might be achieved with the introduction of high temperature superconductors (HTS). Components that are compared in a before and after fashion include transformers, transmission lines, and capacitors. It is concluded that HTS has its greatest effect on the weight associated with transmission lines, where the weight penalty could be reduced by as much as 130 kg/kW/km of cable. Transformers, because 28 percent of their mass is in the conductor, are reduced in weight by the same factor. Capacitors are helped the least with only negligible savings possible. Finally, because HTS can relax the requirement to use alternating current in order to reduce conductor mass, it will be possible to generate significant savings by eliminating most transformers and capacitors. J.P.B.

N88-23556# Hughes Research Labs., Malibu, Calif.
PROSPECTS FOR ANTIPROTON PRODUCTION AND PROPULSION
Robert L. Forward *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 11-26 (For primary document see N88-23555 16-72)
(Contracts F04611-86-C-0039; F04611-83-C-0013; F04611-83-C-0046)
Avail: NTIS HC A13/MF A01 CSCL 21F

23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N88-22940# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A STUDY OF FAILURE CHARACTERISTICS IN THERMOPLASTIC COMPOSITE MATERIAL M.S. Thesis
Robert J. Martin Mar. 1988 236 p
(AD-A190613; AFIT/GA/AA/88M-2) Avail: NTIS HC A11/MF A01 CSCL 11D

The recently introduced thermoplastic composite material, graphite polyetherether-ketone (Gr/PEEK) APC-2, promises lower costs, lower part weight, and higher operating temperatures. This new class of organic material has fracture toughness properties superior to those of graphite epoxy. This thesis examines the failure characteristics of Gr/PEEK through an experimental investigation and through the application of a fully nonlinear ply-by-ply finite element technique. The experimental investigation of Gr/PEEK APC-2 involved the testing of 34 tension and compression coupons to derive basic material properties for use with the finite element program. This investigation provided further data on the application of tensile loads to Gr/PEEK containing circular discontinuities. This study also proved that a nonlinear finite element program can closely approximate progressive ply failure in a Gr/PEEK laminate. This research reinforced the proposition that the thermoplastic matrix does produce a reliable composite that should be considered for use on aircraft, spacecraft, and space facilities. GRA

N88-22941# Centre d'Essais Aeronautique Toulouse (France). Lab. des Materiaux Composites et Organiques.
ELEMENTARY CHARACTERIZATION OF FIBREDUX 913 CTS 5 34 PERCENT PREIMPREGNATED CARBON-EPOXY FROM CIBA GEIGY Final Report [PREIMPREGNE CARBONE/EPOXY FIBREDUX 913 CTS-5-34 PERCENT DE CIBA-GEIGY. CARACTERISATION ELEMENTAIRE. PROCESS-VERBAL M-484300]
24 Jun. 1987 46 p In FRENCH Sponsored by the Service Techniques des Programmes Aeronautiques, Paris, France
(M-484300; ETN-88-91993) Avail: NTIS HC A03/MF A01

A material intended to polymerize at 120C (while the standard currently used for aircraft structure manufacturing polymerizes at 180C) was evaluated. Plain mechanical tests do not show significant differences while the viscoelastic behavior is better than the standard and the sensitivity to heat aging increases. ESA

N88-22942# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Direction Centrale de la Qualite.
DELAMINATION ANALYSIS IN CROSSED LAYER COMPOSITES [ANALYSE DES DECHIRURES TRANSLAMINAIRES SUR COMPOSITES A DRAPAGES CROISES. PROCES-VERBAL 48-447/F]
J. Odorico, M. Vancon, and A. Bard 6 Aug. 1987 83 p In FRENCH
(Contract STPA-85-96-032)
(Rept-48-447/F; ETN-88-91997) Avail: NTIS HC A05/MF A01

Isotropic and 45 deg ply orientation carbon fiber composite materials were subjected to static and cyclic tests, to understand initiation and development of interlayer damage. The analysis methods include visual, acoustic emission, thermography, acoustic microscopy, and radiography. Different aspects of the observed phenomena are reported and classified. The optimum procedure requires the combination of macroscopic observation, radiographic X-ray analysis of the defect, cross section optical micrography, and electron microscopy. ESA

N88-22943# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
HOMOGENIZATION STUDY OF MATRIX BEHAVIOR IN A COMPOSITE MATERIAL Final Report [ETUDE PAR HOMOGENEISATION DU COMPORTEMENT DE LA MATRICE DANS UN MATERIAU COMPOSITE]
J. Renard and L. Anquez Feb. 1987 66 p In FRENCH
(Contract DRET-86-34-001)
(ONERA-RT-1/7256-RY-060-R; ETN-88-92139) Avail: NTIS HC A04/MF A01

Transversal cracks in composites are studied. Local degradation is described by the matrix homogenization method using first a square elementary cell and then an hexagonal one. A criterion of local matrix breaking is introduced. The random distribution of fibers is discussed. The finite element analysis shows that the crack propagation follows a linear evolution, which depends on crack depth. ESA

N88-22944 National Physical Lab., Teddington (England). Div. of Materials Applications.
TEST PROCEDURES AND STANDARDS FOR MECHANICAL PROPERTY MEASUREMENTS ON METAL MATRIX COMPOSITES
B. Roebuck, T. A. E. Gorley, and L. N. McCartney Jan. 1988 52 p
(NPL-DMA(A)153; ISSN-0143-7313; ETN-88-92526) Copyright Avail: National Physics Lab., Teddington, Middlesex, TW11 0LW, United Kingdom

Test procedures and standards for mechanical property measurements on metal matrix composites (MMC) are reviewed, and experience with testing and methods to measure properties is summarized. The mechanical properties which are covered are: tensile, compressive, bend, impact, fracture toughness, and fatigue and creep. Mathematical models to predict the mechanical properties of MMC from a knowledge of the properties of the constituents and their geometry are mentioned. ESA

N88-22945*# National Aeronautics and Space Administration, Washington, D.C.
FATIGUE DAMAGE DEVELOPMENT OF VARIOUS CFRP-LAMINATES
K. Schulte and Ch. Baron May 1988 18 p Transl. into ENGLISH from Zeitschrift fuer Werkstofftechnik (Fed. Republic of Germany), v. 18, Apr. 1987 p 103-110 Original language document was announced in IAA as A87-41552 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20247; NAS 1.77:20247; ISSN-0049-8688) Avail: NTIS HC A03/MF A01 CSCL 11D

The chronic strength and fatigue behavior of a woven carbon-fiber reinforced laminate in a balanced eight-shaft satin weave style was compared to nonwoven laminates with an equivalent cross-ply layup. Half the fibers were arranged in the direction of the load and the other half perpendicular to it. Two types of nonwoven laminates consisting of continuous fibers and aligned discontinuous fibers, both produced from carbon fiber prepregs, were studied. The cross-ply laminate with continuous fiber showed the best characteristics with regard to both static strength and fatigue. The similarities and differences in damage mechanisms in the laminates are described. Author

N88-22946*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
THERMOVISCOELASTIC CHARACTERIZATION AND PREDICTIONS OF KEVLAR/EPOXY COMPOSITE LAMINATES Interim Report, 1 Sep. 1985 - 1 Jun. 1988
K. C. Gramoll, D. A. Dillard, and H. F. Brinson May 1988 303 p
(Contract NCC2-71)
(NASA-CR-182878; NAS 1.26:182878; VPI-E-88-12; CAS/ESM-88-5) Avail: NTIS HC A14/MF A01 CSCL 11D

The thermoviscoelastic characterization of Kevlar 49/Fiberite 7714A epoxy composite lamina and the development of a numerical procedure to predict the viscoelastic response of any general laminate constructed from the same material were studied. The four orthotropic material properties, S sub 11, S sub 12, S sub 22, and S sub 66, were characterized by 20 minute static creep tests on unidirectional (0) sub 8, (10) sub 8, and (90) sub 16 lamina specimens. The Time-Temperature Superposition-Principle (TTSP) was used successfully to accelerate the characterization process. A nonlinear constitutive model was developed to describe the stress dependent viscoelastic response for each of the material properties. A numerical procedure to predict long term laminate properties from lamina properties (obtained experimentally) was developed. Numerical instabilities and time constraints associated with viscoelastic numerical techniques were discussed and solved. The numerical procedure was incorporated into a user friendly microcomputer program called Viscoelastic Composite Analysis Program (VCAP), which is available for IBM PC type computers. The program was designed for ease of use. The final phase involved testing actual laminates constructed from the characterized material, Kevlar/epoxy, at various temperatures and load level for 4 to 5 weeks. These results were compared with the VCAP program predictions to verify the testing procedure and to check the numerical procedure used in the program. The actual tests and predictions agreed for all test cases which included 1, 2, 3, and 4 fiber direction laminates. Author

N88-22947*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
CHARACTERIZATION OF MODE 1 AND MODE 2 DELAMINATION GROWTH AND THRESHOLDS IN GRAPHITE/PEEK COMPOSITES
Roderick H. Martin and Gretchen B. Murri Apr. 1988 52 p Sponsored in part by Army
(DA Proj. 1L1-61102-AH-45-C)
(NASA-TM-100577; NAS 1.15:100577; AVSCOM-TM-88-B-011)
Avail: NTIS HC A04/MF A01 CSCL 11D

Composite materials often fail by delamination. The onset and growth of delamination in AS4/PEEK, a tough thermoplastic matrix composite, was characterized for mode 1 and mode 2 loadings, using the Double Cantilever Beam (DCB) and the End Notched Flexure (ENF) test specimens. Delamination growth per fatigue cycle, da/dN, was related to strain energy release rate, G, by means of a power law. However, the exponents of these power laws were too large for them to be adequately used as a life prediction tool. A small error in the estimated applied loads could lead to large errors in the delamination growth rates. Hence strain energy release rate thresholds, G sub th, below which no delamination would occur were also measured. Mode 1 and 2 threshold G values for no delamination growth were found by monitoring the number of cycles to delamination onset in the DCB and ENF specimens. The maximum applied G for which no delamination growth had occurred until at least 1,000,000 cycles was considered the threshold strain energy release rate. Comments are given on how testing effects, facial interference or delamination front damage, may invalidate the experimental determination of the constants in the expression. Author

N88-22948*# National Aeronautics and Space Administration, Washington, D.C.
THERMAL CONDUCTIVITY, ELECTRICAL CONDUCTIVITY AND SPECIFIC HEAT OF COPPER-CARBON FIBER COMPOSITE
Keiichi Kuniya, Hideo Arakawa, Tsuneyuki Kanai, and Akio Chiba May 1988 18 p Transl. into ENGLISH from Nippon Kinzoki Gakkaishi (Japan), v. 49, no. 10, 1985 p 906-912 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20172; NAS 1.77:20172) Avail: NTIS HC A03/MF A01 CSCL 11D

A new material of copper/carbon fiber composite is developed which retains the properties of copper, i.e., its excellent electrical and thermal conductivity, and the property of carbon, i.e., a small thermal expansion coefficient. These properties of the composite

are adjustable within a certain range by changing the volume and/or the orientation of the carbon fibers. The effects of carbon fiber volume and arrangement changes on the thermal and electrical conductivity, and specific heat of the composite are studied. Results obtained are as follows: the thermal and electrical conductivity of the composite decrease as the volume of the carbon fiber increases, and were influenced by the fiber orientation. The results are predictable from a careful application of the rule of mixtures for composites. The specific heat of the composite was dependent, not on fiber orientation, but on fiber volume. In the thermal fatigue tests, no degradation in the electrical conductivity of this composite was observed. Author

N88-22949*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
TOWARDS A DAMAGE TOLERANCE PHILOSOPHY FOR COMPOSITE MATERIALS AND STRUCTURES
T. Kevin OBrien (Army Aerostructures Directorate, Hampton, Va.) Mar. 1988 63 p
(DA Proj. 1L1-61102-AH-45-C)
(NASA-TM-100548; USAAVSCOM-TM-88-B-009; NAS 1.15:100548) Avail: NTIS HC A04/MF A01 CSCL 11D

A damage-threshold/fail-safe approach is proposed to ensure that composite structures are both sufficiently durable for economy of operation, as well as adequately fail-safe or damage tolerant for flight safety. Matrix cracks are assumed to exist throughout the off-axis plies. Delamination onset is predicted using a strain energy release rate characterization. Delamination growth is accounted for in one of three ways: either analytically, using delamination growth laws in conjunction with strain energy release rate analyses incorporating delamination resistance curves; experimentally, using measured stiffness loss; or conservatively, assuming delamination onset corresponds to catastrophic delamination growth. Fail-safety is assessed by accounting for the accumulation of delaminations through the thickness. A tension fatigue life prediction for composite laminates is presented as a case study to illustrate how this approach may be implemented. Suggestions are made for applying the damage-threshold/fail-safe approach to compression fatigue, tension/compression fatigue, and compression strength following low velocity impact. Author

N88-22950*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SURFACE CRACK ANALYSIS APPLIED TO IMPACT DAMAGE IN A THICK GRAPHITE-EPOXY COMPOSITE
C. C. Poe, Jr., C. E. Harris, and D. H. Morris (Virginia Polytechnic Inst. and State Univ., Blacksburg.) Apr. 1988 33 p
(NASA-TM-100600; NAS 1.15:100600) Avail: NTIS HC A03/MF A01 CSCL 11D

The residual tensile strength of a thick graphite/epoxy composite with impact damage was predicted using surface crack analysis. The damage was localized to a region directly beneath the impact site and extended only part way through the laminate. The damaged region contained broken fibers, and the locus of breaks in each layer resembled a crack perpendicular to the direction of the fibers. In some cases, the impacts broke fibers without making a visible crater. The impact damage was represented as a semi-elliptical surface crack with length and depth equal to that of the impact damage. The maximum length and depth of the damage were predicted with a stress analysis and a maximum shear stress criterion. The predictions and measurements of strength were in good agreement. Author

N88-22951*# Utah Univ., Salt Lake City. Dept. of Materials Science and Engineering.
SURFACE AND INTERFACIAL PROPERTIES OF CARBON FIBERS
W. D. Bascom Apr. 1988 20 p
(Grant NAG1-706)
(NASA-CR-182890; NAS 1.26:182890) Avail: NTIS HC A03/MF A01 CSCL 11D

Differences in the adhesion of three carbon fibers (Hercules AS1 and AS4, and Hysol-Grafil XAS) to polycarbonate (PC) have been shown to correlate with the absorptivity of PC on the three fiber types. The absorptivity (energy of absorption) was determined using retention time liquid chromatography and the adhesion was measured using the single embedded filament tensile test. A correlation was also found between adhesion strength and the O/N surface element ratio using XPS analysis. The chemical details for these correlations have not yet been determined. A study of filament fracture statistics has been initiated using single and multiple embedded filament tensile tests. Filament fracture has been measured as a function of strain and for different interfiber distances. Preliminary results indicate that fiber fracture is a discontinuous function of increasing strain and may in fact occur at discrete strain intervals. Fiber-fiber interaction effects on fiber fracture have been found for interfiber distances of up to two to three fiber diameters. Author

N88-22952# Naval Ocean Systems Center, San Diego, Calif.
A PIECEWISE QUADRATIC STRENGTH TENSOR THEORY FOR COMPOSITES Final Technical Report, 1 Oct. 1986 - 30 Sep. 1987
P. Y. Tang 30 Sep. 1987 60 p
(AD-A190929; AD-E500910; NOSC/TR-1188) Avail: NTIS HC A04/MF A01 CSCL 11D

A piecewise quadratic strength tensor theory for composite materials has been developed and its applicability to the available biaxial fracture data on composites demonstrated. The theory will have application to current composite structures of Naval Ocean Systems Center's interest such as transducers and future composite structures such as torpedo hull section, Vertical Launch ASROC (VLA) nosecaps, and tethered deep submergence structures. The theory can also be used with a wide variety of other NAVY structures such as aircraft and submarine substructures. GRA

N88-22953# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THE ADHESIVE BONDING OF THERMOPLASTIC COMPOSITES Periodic Report No. 4, Aug. - Dec. 1987
A. J. Kinloch and G. K. Kodokian 15 Jan. 1988 16 p
(Contract DAJA45-86-C-0037)
(AD-A190994) Avail: NTIS HC A03/MF A01 CSCL 11D

Successful adhesive bonding of thermoplastic composites has been achieved using corona discharge treatment. Both a physical and chemical analyses was carried out to determine the effects of corons treatment. These analyses confirm that corona treatment increases the wettability and intrinsic adhesion of the materials analyzed by introducing specific chemical groups. GRA

N88-22954# McDonnell Aircraft Co., St. Louis, Mo.
NONDESTRUCTIVE EVALUATION OF LARGE SCALE COMPOSITE COMPONENTS Final Report, 25 Sep. 1984 - 31 Mar. 1987
Daniel C. King, R. D. Lawson, and B. J. Romine Jan. 1988 63 p
(Contract F33615-84-C-5017)
(AD-A190998; AFWAL-TR-87-4116) Avail: NTIS HC A04/MF A01 CSCL 11D

This report covers the development of a reciprocating time-of-flight ultrasonic inspection system capable of rapid scanning of large area composite structures. Representative aircraft composite structures with flaw inclusions were fabricated to evaluate the effects of scanner design, coupling characteristics, part curvature, near and far surface defect detection, imaging, and data acquisition and storage capabilities. The results were used to combine a mechanical scanner, software, and electronics equipment into a working breadboard system. Breadboard evaluation results indicate that a downsized portable system is a viable inspection tool, and produces production quality ultrasonic C-scan images at comparable production scanning rates. GRA

N88-22955# Oxford Univ. (England). Dept. of Engineering Science.
BEHAVIOUR OF FIBRE-REINFORCED COMPOSITES UNDER DYNAMIC LOADING Final Report, 1 May - 14 Nov. 1986
K. Saka, R. K. Li, and J. Harding 30 Oct. 1987 79 p
(Grant AF-AFOSR-0218-85)
(AD-A191310; AFOSR-88-0061TR) Avail: NTIS HC A05/MF A01 CSCL 11D

Stress-strain curves are presented for tensile impact tests on plain-weave glass/epoxy and plain-weave carbon/epoxy laminates loaded in a direction at 45 deg to both the warp and weft directions. From the initial linear-elastic response the in-plane, shear moduli for the two types of reinforcement at impact rates of strain are derived. In conjunction with results previously obtained from tensile impact tests on the same laminates loaded in the warp and the weft directions, two-dimensional stiffness matrices for both the glass-fabric and the carbon-fabric reinforced plies are determined. When compared with similar stiffness matrices previously obtained under quasi-static loading, a marked effect of strain rate is apparent, particularly for the glass-reinforced ply. GRA

N88-22995 Joint Publications Research Service, Arlington, Va.
STRENGTH AND FAILURE RATE OF COMPOSITE MATERIALS WITH CARBON IN CERAMIC MATRIX Abstract Only
E. A. Eskin, G. P. Khristov, A. S. Petrov, V. K. Fedchuk, and A. V. Izotov *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 24-25 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 80-84 Original language document was announced in IAA as A87-43642 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-22956# Bhabha Atomic Research Centre, Bombay (India).
ANALYTICAL CHEMISTRY DIVISION Annual Report, 1985
N. Mahadevan, comp. 1986 94 p
(DE88-701236; BARC-1351) Avail: NTIS HC A05/MF A01

An account of the various activities of the Analytical Chemistry Division of the Bhabha Atomic Research Centre, Bombay, during 1985 is presented. Its main function is to provide chemical analysis support to India's atomic energy program. Also, its analytical services are offered for measurement of concentrations of trace levels to Indian industries and other research organizations. A list of these determinations is given. During the year an ultra trace analytical lab for analysis of critical samples without contamination was set up using indigenous material and technology. DOE

N88-22957# International Business Machines Corp., San Jose, Calif.
STATISTICAL FINE STRUCTURE IN INHOMOGENEOUSLY BROADENED ABSORPTION LINES IN SOLIDS Interim Technical Report
W. E. Moerner and T. P. Carter 22 Dec. 1987 10 p
(Contract N00014-84-C-0708)
(AD-A190341; TR-14) Avail: NTIS HC A02/MF A01 CSCL 20E

By using laser FM spectroscopy, we have observed Statistical Fine Structure (SFS) in the inhomogeneously broadened zero-phonon S1 : SO (O-O) absorption of pentacene molecules in crystals of p-terphenyl at liquid helium temperatures. SFS results from variations in the spectral density of absorbers with optical wavelength due to statistics, illustrating that the inhomogeneous line profile is not a simple, smooth Gaussian function as has been previously assumed but rather contains significant fine structure. Theoretical analysis of the SFS spectra using auto-correlation techniques can be used to estimate the underlying value of the homogenous linewidth. This new observation not only provides a novel way to study the statistics of inhomogeneous broadening, but it also allows estimation of the homogenous width without requiring spectral hole-burning or coherent transient techniques. GRA

N88-22958# Colorado Univ., Boulder.
CHROMATOGRAPHIC AND MASS SPECTROMETRIC SEPARATION AND ANALYSIS Final Scientific Report, 1 Apr. 1984 - 30 Jun. 1987
R. E. Sievers and R. M. Barkley 1 Dec. 1987 8 p
(Grant AF-AFOSR-0093-84)
(AD-A190113; AFOSR-87-1776TR) Avail: NTIS HC A02/MF A01 CSCL 07D

A final scientific report is given for research in the areas of chromatographic separations and mass spectrometry. A new porous polymer containing cobalt has been synthesized and characterized. It has been found to bind molecular oxygen reversibly. Additional characterization has been made of a symmetrical multidendate ligand, when chelated with a suitable metal ion, it potentially may be a new shift reagent for nuclear magnetic resonance spectrometry. Tandem mass spectrometry has been investigated as a new means of characterizing various metal chelates. Significant differences have been observed for fragment ions produced by collisionally activated dissociation compared to electron impact ionization. Chromium chelates of a beta-diketone have shown exceptional stability in chromatographic systems, yielding new procedures for separating various chromium species. Experiments with a supercritical fluid chromatograph have indicated the potential to use the device with selective chromatographic detectors and for separations that are difficult to effect by gas chromatography. Author

N88-22959# National Aerospace Lab., Tokyo (Japan).
MEASUREMENT DATA PROCESSING SYSTEM BASED ON PERSONAL COMPUTER: FOR SCRAMJET COMBUSTION TEST
Kenji Kudo, Tomoyuki Komuro, and Atsuo Murakami Dec. 1986 26 p In JAPANESE
(DE88-751807; NAL-TM-561) Avail: NTIS (US Sales Only) HC A03

A data processing component incorporating a personal computer based measurement system is developed to provide a high-reliability, high accuracy automatized system that can serve effectively for the scramjet combustion tests. New equipment for controlling the operation component of the combustion test apparatus is also produced. The software for the data processing component includes an A/D conversion program, physical quantities conversion program, and performance calculation program. This makes it possible to perform the sampling of experimental data and the primary processing of them immediately in the laboratory. A large-type computer must be used for the secondary processing of the data, as in the case of the conventional system, the new component can send and receive them on line. DOE

N88-22960# Technische Hogeschool, Eindhoven (Netherlands).
INSTRUMENTAL ASPECTS OF CAPILLARY SUPERCRITICAL FLUID CHROMATOGRAPHY Ph.D. Thesis
Robertus Wilhelmus Bally 1987 142 p
(ETN-88-92242) Avail: NTIS HC A07/MF A01

Sample introduction techniques for supercritical fluid chromatography (SFC) are described. Implications of the use of mass flow restrictors in capillary SFC are discussed. Factors determining separation and speed of analysis in capillary SFC are outlined. Liquefied carbon dioxide extraction of solids is summarized. ESA

N88-22961# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Abteilung Energispeichertechnik.
MATERIAL DEGRADATION IN A BARIUM HYDROXIDE LATENT HEAT STORAGE PILOT UNIT
Siegfried Krause and Michael vonBradke Aug. 1987 74 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1107)
(DFVLR-FB-87-49; ISSN-0171-1342; ETN-88-92321) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 29.50 DM

Barium hydroxide's chemical interaction with the heat transfer oil, the stainless steel container, and the ambient air was investigated in a pilot storage unit. Chemical analysis, an electron microscope, and EDX were applied. Degradations observed after 40 test months are remarkably small. Long useful lives may therefore be expected for practical latent heat storage plants. The results also concern latent heat storage at high temperatures in solar dynamic energy systems in space, where the latent heat storage medium and its container also interact. ESA

N88-22962# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de la Physique Generale.
ANTISTOKES COHERENT RAMAN DIFFUSION OF A NITRIDING PLASMA Final Report [ETUDE PAR DRASC D'UN PLASMA DE NITRURATION]
M. Lefebvre and M. Pealat Nov. 1987 35 p In FRENCH
(Contract DRET-86-001)
(ONERA-RF-6/3644-PY; ETN-88-92144) Avail: NTIS HC A03/MF A01

The rotational and vibrational temperature profiles of molecular nitrogen were measured near a nitriding specimen. The specimen was either at the flow discharge or was the cathode itself. The results allow one to separate the flow effects and discharge effects. The data using N2-H2 mixtures show that there is no thermodynamical equilibrium between these two molecule types. ESA

N88-22963# Nevada Univ., Las Vegas. Quality Assurance Lab.
SINGLE-LABORATORY EVALUATION OF SW-846 METHODS 7090/7091 DETERMINATION OF BERYLLIUM BY FLAME AND FURNACE ATOMIC ABSORPTION SPECTROPHOTOMETRY Summary Report, Jan. - Aug. 1987
V. F. Hodge, D. A. Darby, W. E. Thompson, and C. L. Jones Feb. 1988 140 p
(Contract EPA-68-01-7159)
(PB88-171434; QAL-168; EPA-600/4-88-012) Avail: NTIS HC A07/MF A01 CSCL 07D

The results of a single-laboratory study of the Determination of Beryllium by Flame and Furnace Atomic Absorption Spectrophotometry, are described. The study examined the application of these two powerful beryllium detection methods to the analysis of selected liquid and solid samples after digestion by appropriate SW-846 methods. Method performance data including detection limits, optimum concentration ranges (linearity), spike recoveries, interferences, precision, accuracy, and optimum operating parameters are presented and discussed. Author

N88-22964# Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
SYNTHESIS AND PROPERTIES OF NOVEL CLUSTER PHASES Progress Report
F. DiSalvo 1988 10 p
(Contract DE-FG02-87ER-45298)
(DE88-006816; DOE/ER-45298/1) Avail: NTIS HC A02/MF A01

A large number of group VI cluster compounds (primarily Mo halides, oxides, and chalcogenides) and group IV cluster compounds (primarily Zr halides) are known to exist. Many more cluster compounds containing the group V elements Nb and Ta should also exist. Large quantities of Nb6I11 by reaction of Nb3I8 with Nb metal in welded Nb metal tubes at 900C have been prepared. Also we are using Ta2CS2 as a starting reagent in an attempt to make compounds that contain Ta6CS8 clusters. Similarly Nb2CS will be used as a reagent to prepare Nb6CS8 cluster compounds. A major aspect of our cluster program is to further study the solutions of infinite, metallic chains of Mo3X3 and to put Mo sub 3n X sub 3n+2 clusters in solution (X may be S, Se, or Te). We have prepared solutions of LiMo3Se3 and begun to study the compatibility of the Mo3Se3 polymer (or polymeric-polyelectrolyte) with organic polymers. Finally, several compounds containing condensed Mo6Se8 clusters have been prepared including CsMo3Se3 and Cs2Mo12Se14. These will be used as precursors for the preparation of the corresponding lithium salts. DOE

N88-22965*# National Aeronautics and Space Administration, Washington, D.C.
A THEORETICAL AND EXPERIMENTAL STUDY OF THE THERMOPHYSICAL PROPERTIES OF LITHIUM HYDRIDE
E. E. Shpilrain, K. A. Yakimovich, D. N. Kagan, and V. G. Shvalb Apr. 1988 11 p Transl. into ENGLISH of conference paper presented at the 4th Teplofizicheskie Svoistve Zhidkostei Materialy Vsesoyuznoi Teplofizicheskoi Konferentii, 1971 p 7-13 Conference held in Odessa, USSR, May 1971 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20179; NAS 1.77:20179) Avail: NTIS HC A03/MF A01 CSCL 07D

Results of a comprehensive study of LiH in its condensed and vapor phases are given. These studies were carried out at the Institute of High Temperature of the Academy of Sciences of the USSR. The caloric properties of the condensed phase were measured at a temperature interval of 400 to 1400 K by the mixing method using a calorimeter and an evaporating liquid. Results of the four series of experiments, subjected to the least squares method, are approximated by equations. Author

N88-22966*# Arizona State Univ., Tempe. Dept. of Geology.
IMPACT-INDUCED DEVOLATILIZATION AND HYDROGEN ISOTOPIC FRACTIONATION OF SERPENTINE: IMPLICATIONS FOR PLANETARY ACCRETION
James A. Tyburczy, R. V. Krishnamurthy, Samuel Epstein, and Thomas J. Ahrens (California Inst. of Tech., Pasadena.) [1988] 36 p
(Grants NGL-05-002-105; NAG9-46)
(NASA-CR-182877; NAS 1.26:182877) Avail: NTIS HC A03/MF A01 CSCL 07D

Impact-induced devolatilization of porous serpentine was investigated using two independent experimental methods, the gas recovery and the solid recovery method, each yielding nearly identical results. For shock pressures near incipient devolatilization, the hydrogen isotopic composition of the evolved H2O is very close to that of the starting material. For shock pressures at which up to 12 percent impact-induced devolatilization occurs, the bulk evolved gas is significantly lower in deuterium than the starting material. There is also significant reduction of H2O to H2 in gases recovered at these higher shock pressures, probably caused by reaction of evolved H2O with the metal gas recovery fixture. Gaseous H2O-H2 isotopic fractionation suggests high temperature isotopic equilibrium between the gaseous species, indicating initiation of devolatilization at sites of greater than average energy deposition. Bulk gas-residual solid isotopic fractionations indicate nonequilibrium, kinetic control of gas-solid isotopic ratios. Impact-induced hydrogen isotopic fractionation of hydrous silicates during accretion can strongly affect the long-term planetary isotopic ratios of planetary bodies, leaving the interiors enriched in deuterium. Depending on the model used for extrapolation of the isotopic fractionation to devolatilization fractions greater than those investigated experimentally can result from this process. Author

N88-22967# Texas Univ., Austin. Dept. of Chemistry.
ELECTROCHEMISTRY IN NEAR-CRITICAL AND SUPERCRITICAL FLUIDS. 5: THE DIMERIZATION OF QUINOLINE AND ACRIDINE RADICAL ANIONS AND DIANIONS IN AMMONIA FROM -70 C TO 150 C
Richard M. Crooks and Allen J. Bard Jul. 1987 50 p

(Contract N00014-84-K-0428)
(AD-A190858; TR-7-Pt-5) Avail: NTIS HC A03/MF A01 CSCL 07F

An experimental apparatus capable of supporting electrochemical measurements in ammonia at high temperatures and pressures is described. The dimerization reactions of the radical anions of quinoline and acridine were studied over a 220 C temperature range in ammonia. The cyclic voltammetric and chronoamperometric experiments were analyzed by the theory for reversible dimerizations. At low temperature the dimerization was totally irreversible, but at elevated temperatures the rate of the back reaction was significant and the dimerization reaction was facile. The rates of the dimerization reactions were extrapolated to very high temperature, and were found to be in qualitative agreement with cyclic voltammetric results in supercritical ammonia. The activation energies for the dimerization reactions are reported. The diffusion coefficients of quinoline and acridine from -70 C to 150 C are reported. GRA

N88-22968# IBM Research Lab., San Jose, Calif.
STATISTICAL FINE STRUCTURE IN THE INHOMOGENEOUSLY BROADENED ELECTRONIC ORIGIN OF PENTACENE IN p-TERPHENYL
T. P. Carter, M. Manavi, and W. E. Moerner 29 Jan. 1988 49 p
(Contract N00014-84-C-0708)
(AD-A191211; TR-15) Avail: NTIS HC A03/MF A01 CSCL 07D

Recently, the first observation of statistical fine structure on an inhomogeneously broadened absorption profile was reported for mixed crystals of pentacene in p-terphenyl using laser FM spectroscopy. Statistical fine structure is time-independent structure on the inhomogeneous line caused by statistical variations in the spectral density of absorbers in each frequency interval. In this work, a model and an analysis of statistical fine structure using autocorrelation techniques are presented, and the dependence of the effect for pentacene in p-terphenyl at 1.4K on modulating frequency, detection phase, sample position, center concentration, and site is described. GRA

N88-22969# Amherst Coll., Mass. Dept. of Chemistry.
SURFACE ENHANCED RAMAN SCATTERING APPLIED TO SURFACE CHEMICAL KINETICS
Paul B. Dorain 15 Feb. 1988 11 p
(Contract N00014-85-K-0105)
(AD-A191275; TR-7) Avail: NTIS HC A03/MF A01 CSCL 07D

Surface enhanced Raman scattering (SERS), has the potential to be a powerful tool in the study of surface chemical reaction processes. Sensitive to less than monolayer coverage even under ambient conditions, SERS has been used to obtain detailed surface reaction kinetics in only a few cases. The applications of SERS to study surface chemical reaction kinetics is presently limited because the enhancement mechanisms are reaction dependent. That is, the size and the number density of the surface roughness is dependent on the reaction parameters, such as delta H and temperature that are functions of time. For selected reactions, a partial solution exists if during the course of the reaction, surface reconstruction is confined to modification of the adatom structures. Electromagnetic enhancement, due to surface roughness of approx 20nm, is nearly constant in this case, and only the adatom enhancement mechanism is time dependent. The adatom concentration is also proportional to the background intensity due to electron-hole recombination in the metal substrate. Thus the adatom time dependence of the SERS spectra may be removed by normalization to the background in a spectral region without discrete SERS peaks. Applications to the decomposition of allynes, phosphonates, and NO2 on silver powders provide supportive evidence. GRA

N88-22970# Mississippi Univ., University. Physical Acoustics Research Lab.
THE EFFECT OF INTERNAL RELAXATION ON OPTOACOUSTIC CONVERSION IN LIQUIDS
Charles Thompson and Henry E. Bass 5 Feb. 1988 62 p
(Contract N00014-84-C-0193)
(AD-A191307; PARGUM-88-01) Avail: NTIS HC A04/MF A01 CSCL 07D

In the optoacoustic effect, optical energy is adsorbed by a medium and converted to translational energy, creating an acoustic signal. In most liquids, the conversion process takes place very rapidly (ps or fs) and the nonradiative decay time is much shorter than the resulting acoustic signal. Theories have been developed, based purely on geometrical considerations, which accurately predict the optoacoustic signal in such cases. The results show that for a short pulse of optical energy the time dependence of the acoustic pressure is determined by the size and shape of the excitation zone. This research was concerned with the actual energy transfer process and how variations in the process which exist from one liquid to another will affect the optoacoustic signal. The purpose of this study was to observe the optoacoustic signal in a situation where nonradiative decay is slow enough to compete with the geometry of the excitation zone in determining the time dependence of the acoustic pressure, and to develop a model to predict the signal in such a situation. GRA

N88-22971# Indiana Univ., Bloomington. Dept. of Chemistry.
UNIVERSAL DETECTION OF IONS BY REPLACEMENT-ION CHROMATOGRAPHY EMPLOYING AN ANION-REPLACEMENT METHOD AND AN ULTRAVIOLET-VISIBLE SPECTROPHOTOMETRIC DETECTOR
Leonard J. Galante and Gary M. Hieftie 22 Feb. 1988 42 p
(Contract N00014-86-K-0366)
(AD-A191326; INDU/DC/GMH/TR-88-21) Avail: NTIS HC A03/MF A01 CSCL 07D

A new ion-chromatographic (IC) detection method involving replacement-ion chromatography (RIC) and an anion-replacement arrangement is employed for cation and anion analysis. In the instrument, a conventional dual-column IC system is followed by a continuously regenerated anion-exchange (ionomeric) fiber, which serves as the replacement column. This third column converts all ionic solutes into their iodate or nitrate salts, which are detected sensitively at 215 nm by a UV-visible spectrophotometer. This detection method is especially useful for cation separation, for which the influence of various system parameters are discussed in detail. Good precision (RSD less than 5 percent), low detection limits (1 to 15 ng), and universal calibration were achieved for several monovalent cations. However, the method does not appear to be useful for anion determinations. GRA

N88-22972# Modena Univ. (Italy).
THE OPTICAL PROPERTIES OF AEROSOLS Periodic Report, 1 May - Aug. 1987
F. Borghese Aug. 1987 4 p
(Contract DAJA45-86-C-0003)
(AD-A191420; PR-1) Avail: NTIS HC A02/MF A01 CSCL 07D

This report focuses on two points: (1) interpretation of the experimental data now available on the scattering properties of single clusters; (2) extension of the present formalism for the macroscopic optical constants of a dispersion of scatterers to the high-density limit. In view of the difficulty of handling small clusters such as those actually forming the aerosols, the experiments are performed by means of a microwave device using as a target an arrangement of spheres reproducing on an appropriately large scale the cluster of interest. As the refractive index is a function of the frequency, the raw results obtained in this way are appropriately scaled down to yield those for a microscopic cluster illuminated by infrared radiation. Presently there exist a few attempts to describe the optical constants of a high-density dispersion of scatterers based on statistical considerations to simulate the actual dispersion. Among these attempts the most interesting from a computational point of view is that of Varadan, Bringi and Varadan

who use the quasi-crystalline approximation of Lax to get solvable equations. A more sophisticated kind of statistics is used to go beyond this. GRA

N88-23098*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PREMIXED TURBULENT FLAME CALCULATION
S. El-Tahry, C. J. Rutland, J. H. Ferziger (Stanford Univ., Calif.), and M. M. Rogers *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 121-131 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 21B

N88-23565# Lawrence Livermore National Lab., Calif.
INFRARED SPECTROSCOPY OF H3(+)
Mark Crofton *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 121-124 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07D

N88-23566# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Science Div.
VIBRATIONAL SPECTROSCOPY OF THE HYDROGEN AND HYDRATED HYDRONIUM CLUSTER IONS
L. I. Yeh, M. Okumura, J. D. Myers, and Y. T. Lee *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 127-141 (For primary document see N88-23555 16-72)
(Contract DE-AC03-76SF-00098; Grant NSF CHE-79-16250)
Avail: NTIS HC A13/MF A01 CSCL 07D

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-22973*# National Aeronautics and Space Administration, Washington, D.C.
EFFECTS OF COLD WORKING ON PRECIPITATION IN AGE HARDENABLE ALLOYS: ON THE COPPER ALLOYS
Y. Murakami and O. Kawano May 1988 17 p Transl. into ENGLISH from Nippon Kinzoku Gakkaishi, Journal of Japan Institute of Metals (Japan), v. 21, 1957 p 724-728 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20164; NAS 1.77:20164; Rept-1) Avail: NTIS HC A03/MF A01 CSCL 11F

Experiments were carried out to examine the effects of cold working on the rate of precipitation in binary polycrystalline Cu-Ti, Cu-Cr and Cu-Fe alloys by measurements of electrical resistance, microhardness and thermoelectromotive force. In Cu-Ti alloys, in which the existence of the intermediate phase in precipitation process was suggested from the previous experiments, the electrical resistance measurements provided evidence that at lower aging temperature (220 C) the rate of precipitation of cold working specimens is less than that of unworked specimen, and that at higher temperature cold working accelerates the process. In either Cu-Cr alloys or Cu-Fe alloys, such a suppressive effect of cold working is found at lower temperature, too, although not so remarkable as in the Cu-Ti alloys. On the other hand, in copper of high purity, such an effect is not found. It is suggested that the rate of precipitation at lower temperature in cold working specimens is retarded by the stronger binding interaction between solute atoms and lattice defects, and this interaction effect is more remarkable in the Cu-Ti alloys. Author

N88-22974# Admiralty Materials Lab., Poole (England).
A MODIFIED SULPHURIC ACID ANODISING PROCESS USED AS A PRETREATMENT FOR THE ADHESIVE BONDING OF ALUMINUM ALLOYS
D. A. Moth May 1987 19 p
(ARE-TM(UMM)-87410; BR102512; ETN-88-91913) Copyright Avail: NTIS HC A03/MF A01

A pretreatment for the adhesive bonding of aluminum alloys is described. The process uses sulfuric acid anodizing, followed by a phosphoric acid dip. The advantages of the process are compared with existing systems such as phosphoric acid anodizing and chromic acid anodizing. Using a modified single lap shear test piece designed to give realistic accelerated aging of bonded joints, the pretreatment was tested and found to outperform the best of the alternative treatments. Fracture surfaces were studied and the failure of locii of the process identified. The success of the pretreatment is seen to be intrinsic to the oxide which is easily wetted by the adhesive after phosphoric acid dip etching, and is receptive to adhesive penetration; the pores being straight and having a regular nonconvoluted structure. ESA

N88-22975# Rouen Univ. (France). Lab. de Microscopie Ionique.
ATOMIC BEAM STUDY OF CRYSTALLINE ORDER AND PRECIPITATION IN NICKEL BASED ALLOYS Final Report [ETUDE A LA SONDE ATOMIQUE DE LA MISE EN ORDRE ET DE LA PRECIPITATION DANS LES ALLIAGES A BASE NICKEL]
Sylvain Chambreland 1987 31 p In FRENCH
(Contract DRET-85-1424-DS-SR2)
(ETN-88-91994) Avail: NTIS HC A03/MF A01

The role of Al in Ni3FeAl alloys is studied. The atomic beam scattering method was used to characterize single phase and double phase crystal growth and large order composition fluctuations at the limit of the ordered regions. The results indicate for an Ni3FeO.76AlO.24 alloy that layers of pure Ni atoms alternate with mixed layers 50 percent Ni, 50 percent Al, Fe. The defects in this type of structure are described and discussed. The precipitation phenomena are of the same type as those found in tempering. ESA

N88-22976# Institut de Mecanique Polytechnique de Lorraine, Nancy (France). Lab. de Metallurgie.
TITANIUM POWDER FRIT MADE DURING THE TRANSFORMATION ALPHA-BETA Final Report [FRITTAGE DES POUDRES DE TITANE DURANT LA TRANSFORMATION ALPHA-BETA]
Denis Lerich, Elisabeth Gautier, and Andre Simon 1987 69 p In FRENCH
(Contract DRET-84-195)
(ETN-88-91999) Avail: NTIS HC A04/MF A01

After determining the thermomechanical behavior of the bulk material, sintering experiments were performed using the TA6V4 titanium alloy at varying heat treatment conditions. Thermodilatometry was used to estimate the sintering kinetics as a function of temperature and time. The contribution of a phase transformation is estimated. It is shown that density rates of the order of 99 percent are attainable by temperature cycling or by isothermal beta phase 1040 C treatment. ESA

N88-22977 National Physical Lab., Teddington (England). Div. of Materials Applications.
ANALYSIS OF REVERSIBLE AND IRREVERSIBLE HYDROGEN TRAPPING IN METALS
D. H. Ferriss and A. Turnbull Jan. 1988 18 p
(NPL-DMA(A)154; ISSN-0143-7313; ETN-88-92527) Copyright Avail: National Physics Lab., Teddington, Middlesex, TW11 0LW, United Kingdom

The effect of reversible and irreversible trapping on hydrogen atom transport in metals was analyzed, with emphasis on steels. The extent of fractional occupancy of both types of trapping sites is considered, enabling saturation effects to be assessed. The nonlinear nature of the equations necessitates the use of numerical analysis and the mathematical method is described. Results are analyzed in terms of the normalized permeation flux, which is the most accessible experimental parameter. The results agree with those of other workers. The steepness of the permeation transient

is shown to increase with increasing occupancy of reversible and irreversible trap sites. The effect on the permeation transient of increasing occupancy of reversible trapping sites can be assessed by repetitive charging experiments under varying charging conditions. ESA

N88-22978# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. National Engineering Lab.
THE WELDABILITY OF CONSOLIDATED RAPIDLY SOLIDIFIED TYPE 304 SS POWDERS
D. E. Clark and G. E. Korth 1988 10 p Presented at the 2nd International Conference of Rapidly Solidified Materials, San Diego, Calif. 7 Mar. 1988
(Contract DE-AC07-76ID-01570)
(DE88-006738; EGG-M-27487; CONF-880358-3) Avail: NTIS HC A02/MF A01

The joining requirements of rapidly solidified materials were evaluated. Type 304 stainless steel produced by centrifugal atomization and consolidated by hot extrusion was the primary material tested; vacuum gas atomized Type 304 SS materials and other consolidation methods, including HIP and dynamic (explosive) consolidation, were also examined. Several welding processes were evaluated, including gas tungsten arc, electron beam, friction, capacitor discharge, and explosive welding. Heat-affected zone grain growth was suppressed. Residual helium in the centrifugally atomized material was found to form moderate to severe porosity in all fusion welding processes; porosity appeared to be suppressed in friction and explosive welding. High energy density fusion welding processes (electron beam and capacitor discharge) were thermally modeled, and solidification was found to occur at cooling rates far exceeding those of the original powder material and to produce correspondingly fine microstructures. DOE

N88-22979*# National Aeronautics and Space Administration, Washington, D.C.
QUESTION ON THE MEASUREMENT OF THE METAL WORK FUNCTION IN AN ELECTRON SPECTROMETER BY THE SECONDARY-ELECTRON EMISSION THRESHOLD METHOD
N. V. Alov and K. A. Dadayan Apr. 1988 7 p Transl. into ENGLISH from Pisma Zhurnal Tekhnicheskai Fiziki (USSR), v. 13, no. 5, 13 Mar. 1987 p 290-293 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20190; NAS 1.77:20190) Avail: NTIS HC A02/MF A01 CSCL 11F

The feasibility of measuring metal work functions using the secondary emission threshold method and an electron spectrometer is demonstrated. Measurements are reported for Nb, Mo, Ta, and W bombarded by Ar(+) ions. Author

N88-22980*# National Aeronautics and Space Administration, Washington, D.C.
AUGER ELECTRON SPECTROSCOPY OF CONTRAST-FORMING LAYERS ON METALS
Siegfried Hoffmann and Hans Eckart Exner Apr. 1988 13 p Transl. into ENGLISH from Z. Metallkde (Fed. Republic of Germany), v. 65, 1974 p 778-781 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20182; NAS 1.77:20182) Avail: NTIS HC A03/MF A01 CSCL 11F

As shown by Auger electron spectroscopy, the layers formed during contrasting metallographic polished Cu and Ni with an apparatus using intense electron bombardment consist of metal sputtered from the Au, Fe, or Pb cathode. This layer takes up oxygen from the residual atmosphere. The mechanism of contrast enhancement is the same as that of vapor-deposited interference layers. Author

N88-22981*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARACTERIZATION OF PRECIPITATES IN A NIOBIUM-ZIRCONIUM-CARBON ALLOY Final Report
T. L. Grobstein and R. H. Titran 1986 18 p Presented at the Metallurgical Society Fall Meeting, Orlando, Fla., 5-9 Oct. 1986; sponsored by AIME
(Contract DE-AI03-86SF-16310)
(NASA-TM-100848; DOE/NASA/16310-6; E-4041; NAS 1.15:100848) Avail: NTIS HC A03/MF A01 CSCL 11F

A niobium alloy with 1 percent zirconium and 0.063 percent carbon by weight was investigated in the as-rolled and annealed conditions, and after high-temperature (1350 and 1400 K) exposure with and without an applied stress. In the as-rolled and annealed conditions, large metastable carbides were observed in addition to a regular distribution of small particles. During the high-temperature exposure, the majority of the large carbides were dissolved and a more stable carbide phase formed. This finely dispersed phase had a composition determined to be approximately 70 percent ZrC and approximately 30 percent NbC and showed some evidence of an orientation relationship with the matrix. The precipitates appeared to coarsen slightly after approximately 5000 hr exposure in the presence of an applied stress resulted in a decrease in the size and in the interparticle spacing of the stable precipitates. However, the composition of the precipitate phase and its ability to pin dislocations were not affected by the temperature or stress conditions. Author

N88-22982# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanical Engineering.
DYNAMIC FRACTURE TOUGHNESS EVALUATION BY MEASUREMENT OF CTOD
William N. Sharpe, Jr., Andrew S. Douglas, and Jason M. Shapiro Feb. 1988 89 p
(WNS/ASD-88-02) Avail: NTIS HC A05/MF A01

Quantification of the dynamic fracture toughness of structural materials is essential to a wide range of problems-from nuclear accidents to ordnance applications. However, the difficulties associated with accurate measurements of crack under dynamic loading are considerable. Thus there are no standardized procedures and few reliable results. A systematic study of the dynamic fracture toughness of SAE-01 tool steel, 4340 and HY100 steels, and a tungsten are described using the Interferometric Strain/Displacement Gage (ISDG) system which has very high frequency resolution. The ISDG system is used to measure the crack tip opening displacement (CTOD) 100 microns behind a fatigue crack tip in a three-point bend specimen. Static measurements on similar specimens serve to calibrate the method and ensure consistency with the accepted procedures for static fracture toughness testing. Finite element analyses are used to obtain full field information at the point of initiation and to assess the material characteristics which lead to changes in toughness with loading rate. The major advantage of the method is that information is obtained very close to the crack tip, so that stress wave loading effects are accounted for. Results show that 4340 steel, which is strain-rate insensitive, has no significant change in toughness with loading rate. Measurable toughness dependence on loading rate is found for HY-100 and tungsten, which are approximately 15 percent tougher under dynamic conditions. The SAE-01 tool steel shoes a significant increase (50 percent) in fracture toughness for dynamic over static loading. Author

N88-22983*# Alabama Univ., Birmingham. Dept. of Materials Engineering.
A STUDY OF SURFACE TENSION DRIVEN SEGREGATION IN MONOTECTIC ALLOY SYSTEMS Final Report
J. Barry Andrews, Rosalia N. Andrews, and Terrell F. Gowens Jun. 1988 34 p
(Grant NAG8-049)
(NASA-CR-182894; NAS 1.26:182894) Avail: NTIS HC A03/MF A01 CSCL 11F

The compatibilities of various monotectic alloy systems with several different crucible materials were evaluated. The study was carried out using small candidate alloy samples of compositions that produced fifty volume percent of each liquid phase at the monotectic temperature. Compatibility was based on the evaluation of the wetting tendency of the two immiscible phases with the

crucible material in a one-g solidified sample. Three types of wetting phenomena were observed during the evaluation. Type 1 indicates an alloy-crucible combination where the L2 phase preferentially wets the crucible material. Since L2 is usually the minority phase in desirable alloys, this material combination would be difficult to process and is therefore considered incompatible. Type 2 behavior indicates an alloy-crucible combination where the L1 phase preferentially wets the crucible material. This type of combination is considered compatible since surface tension effects should aid in processing the alloy to a useful form. Type 3 indicates any combination that leads to major reactions between the alloy and crucible material, gas entrapment, or separation of the metal from the crucible wall. Additional compatibility evaluations would have to be carried out on combinations of this category. The five alloy systems studied included aluminum-bismuth, copper-lead, aluminum-indium, aluminum-lead and cadmium-gallium. The systems were combined with crucibles of alumina, boron nitride, mullite, quartz, silicon carbide and zirconia. M.G.

N88-22984# Pennsylvania State Univ., University Park. Dept. of Materials Science and Engineering.
DEFORMATION OF RAPIDLY SOLIDIFIED DISPERSION STRENGTHENED TITANIUM ALLOYS
S. L. Kampe and D. A. Koss Dec. 1987 37 p
(Contract N00014-86-K-0381)
(AD-A190793; TR-8) Avail: NTIS HC A03/MF A01 CSCL 11F

The influence of erbium on the flow behavior of titanium and titanium-aluminum base alloys has been investigated over a range of strain rates and temperatures (25 to 775 C). Data from hot-extruded bulk specimens indicate that, although oxide dispersion strengthening can be large under certain conditions, the strengthening is minimal in fine-grain material subjected to low strain-rate deformation at high temperatures. Both micro-structural observations and an analysis of the flow data indicate profuse grain boundary sliding under these conditions. Grain coarsening anneals, which also coarsen the dispersoids and increase their population along grain boundaries, result in significantly improved high temperature flow strengths, especially in the high temperature/low strain-rate regime. GRA

N88-22985# Naval Surface Weapons Center, Silver Spring, Md.
CORROSION OF ELECTROLESS NICKEL-COATED STEEL Technical Review, Jan. - May 1986
J. F. McIntyre, S. M. Hoover, C. M. Dacres, and K. A. Musselman
1 Apr. 1987 38 p
(AD-A191045; NSWC/TR-87-178) Avail: NTIS HC A03/MF A01 CSCL 11C

The corrosion behavior of electroless nickel-coated steel has been investigated. The effectiveness of electroless nickel as a coating is strongly dependent on the film homogeneity, thickness, and phosphorous content. Defective electroless nickel coatings are detrimental because of galvanic interaction between the coating and the steel substrate. GRA

N88-22986*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIQUE CRACK GROWTH BEHAVIOR OF A SINGLE CRYSTAL ALLOY AS OBSERVED THROUGH AN IN SITU FATIGUE LOADING STAGE
Jack Telesman and Peter Kantzos 1988 19 p Proposed for presentation at the SAMPE Metals Processing Conference, Dayton, Ohio, 2-4 Aug. 1988
(NASA-TM-100863; E-4080; NAS 1.15:100863) Avail: NTIS HC A03/MF A01 CSCL 11F

An in situ fatigue loading stage inside a scanning electron microscope (SEM) was used to determine the fatigue crack growth behavior of a PWA 1480 single-crystal nickel-based superalloy. The loading stage permits real-time viewing of the fatigue damage processes at high magnification. The PWA 1480 single-crystal, single-edge notch specimens were tested with the load axis parallel to the (100) orientation. Two distinct fatigue failure mechanisms were identified. The crack growth rate differed substantially when the failure occurred on a single slip system in comparison to multislip system failure. Two processes by which crack branching is produced were identified and are discussed. Also discussed are the observed crack closure mechanisms. Author

N88-22987*# Syracuse Univ., N. Y. Dept. of Mechanical and Aerospace Engineering.
THE ANALYSIS OF FATIGUE CRACK GROWTH MECHANISM AND OXIDATION AND FATIGUE LIFE AT ELEVATED TEMPERATURES Final Contractor Report
H. W. Liu May 1988 12 p
(Grant NAG3-348)
(NASA-CR-182129; NAS 1.26:182129) Avail: NTIS HC A03/MF A01 CSCL 11F

Two quantitative models based on experimentally observed fatigue damage processes have been made: (1) a model of low cycle fatigue life based on fatigue crack growth under general-yielding cyclic loading; and (2) a model of accelerated fatigue crack growth at elevated temperatures based on grain boundary oxidation. These two quantitative models agree very well with the experimental observations. Author

N88-22989 Joint Publications Research Service, Arlington, Va.
MODEL STUDY OF THERMAL STRESSES IN GAS-TURBINE BLADES WITH PROTECTIVE COATING Abstract Only
G. N. Tretyachenko, K. P. Buyskikh, L. V. Kravchuk, and G. R. Semenov *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 4 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 67-70
(For primary document see N88-22988 16-27)
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27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N88-22988 Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: MATERIALS SCIENCE
17 Mar. 1988 63 p Transl. into ENGLISH from various Russian articles
(JPRS-UMS-88-006) Copyright Avail: Issuing Activity

Scientific and technological articles from Soviet books and journals in the subject area of materials science are translated and presented. More specific areas of study are: Analysis and Testing; Coatings; Composite Materials; Ferrous Metals; Nonferrous Metals and Alloys; Nonmetallic Materials; and Welding, Brazing and Soldering. For individual titles, see N88-22989 through N88-22996.

N88-22989 Joint Publications Research Service, Arlington, Va.
MODEL STUDY OF THERMAL STRESSES IN GAS-TURBINE BLADES WITH PROTECTIVE COATING Abstract Only c26
G. N. Tretyachenko, K. P. Buyskikh, L. V. Kravchuk, and G. R. Semenov *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 4 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 67-70
(For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

A model study of thermal stresses in gas turbine blades with protective coating was made, such blades being simulated by nine different wedges of the ZhS6U heat resistant alloy. Wedges of different sizes and chords were coated by electron beam method with Ni-Co-Cr-Al-Y, Ni-Cr-Al-Y, and Co-Cr-Al-Y alloys. For comparison, one wedge of each size was not coated. These wedges were tested under a heat load simulation. The test results based on measurement of surface temperature indicate that a proper coating can increase the asymmetry of the thermal load cycle with a shift of stresses more into the compressive range

while lowering their amplitude so that such a coating will not only protect blades against corrosion and erosion but also raise their mechanical load capacity. Author

N88-22990 Joint Publications Research Service, Arlington, Va.
DEPENDENCE OF STRUCTURE OF STABILIZED ZrO2 COATINGS ON CONDENSATION RATE Abstract Only
A. M. Martirosyan, V. V. Grabin, N. I. Grechanyuk, I. Ya. Dzykovich, A. A. Trofimenko, and A. L. Samsonov *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 4-5 Transl. into ENGLISH from Problemy Spetsialnoy Elektrometallurgii (Kiev, USSR), no. 2, Apr. - Jun. 1987 p 47-51 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

An experimental study of ZrO2 coatings stabilized with Y2O3 for gas turbine blades was made, its purpose being to find the causes for their high thermal shielding capability as well as their proneness to peeling off the heat resistant steel. The coating material was produced by mixing powders of pure ZrO2 and high purity Y2O3 in a 23:2 ratio and then pressing the mixture. These rods were coated by means of electron beam under a vacuum with an 8 percent Y2O3 stabilizer. These specimens were then heat treated. The bond strength was measured by counting the number of thermal cycles withstood. Microstructural exams with quantitative x-radiographic analyses and microhardness measurements revealed formation of two layers. Coatings produced by condensation at a rate of 0.56 micron/min withstood more than 20 thermal cycles, those produced by condensation at a rate of 1.52 micron/min broke down after one or two cycles. Author

N88-22991 Joint Publications Research Service, Arlington, Va.
DURABILITY OF COMPOUND CYLINDER UNDER STATIC INTERNAL-PRESSURE REPEAT LOAD OF LONG DURATION Abstract Only **c39**
G. P. Zaytsev, G. V. Arkhipov, and N. M. Kopyl *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 7 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 42-47 Original language document was announced in IAA as A87-43639 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

The durability of a polymer metal composite container subjected to prolonged repeated static loading by internal pressure is calculated from the stressed state of the polymer and metal layers using the hypothesis of linear damage accumulation and long term strength characteristics of the polymer layers. The stressed state of the container is estimated on the basis of the zero moment theory of anisotropic shells. It is shown that defects in the metal layer may develop into through-the-thickness defects as a result of increasing stresses and strains in the metal due to stress redistribution during the creep of the composite. E.R.

N88-22992 Joint Publications Research Service, Arlington, Va.
NEW METHOD OF GRAFTING CRYSTALS **c76**
N. Krivenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 20-22 Transl. into ENGLISH from Tekhnika i Nauka (Moscow, USSR), no. 5, May 1987 p 16-17 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

Different uses of crystals in various technologies are given. Then, a method of solid phase grafting worked out for a wide range of crystals: semiconductors (silicon, germanium, boron, gallium arsenide), for quantum electronics (ruby, sapphire, garnets, magnesium oxide), piezoelectric (quartz, zinc oxide), and super ion (zirconium oxide, hafnium oxide) is given. The electrical conductivity of semiconductor crystal depends on its structure and impurity composition. The method and the quality of the crystals produced is studied. E.R.

N88-22993 Joint Publications Research Service, Arlington, Va.
EFFECT OF UNIAXIAL COMPRESSION ON PHYSICAL AND MECHANICAL PROPERTIES OF FERROELECTRIC CERAMIC MATERIAL Abstract Only
S. P. Kovalev, G. G. Pisarenko, and V. K. Khaustov *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 23 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 74-77 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

An experimental study of aged TsTBS-3 ferroelectric piezoceramic material was made to determine the effect of an electrostatic field and then uniaxial compression on its complex dielectric permittivity and the relaxation of the latter. An electric field was applied and the permittivity measured on bar specimens. This test was performed 5 times with a constant electric field of successive intensity. Static uniaxial compression was then applied and slowly removed. This test was performed 4 times with compression in the direction of residual electric polarization and with different pressures as well as 4 times with compression perpendicular to the direction of residual electric polarization and different pressure. The results indicate a nonlinear relaxation process with the real capacitance relaxing faster than the loss tangent. The evidently appreciable effect of uniaxial compression when parallel to the direction of residual electric polarization but not when perpendicular to itself, is explained by a reorientation of domains with attendant stress relief. Author

N88-22994 Joint Publications Research Service, Arlington, Va.
STRENGTH AND CRACKING RESISTANCE OF CERAMICS. REPORT 3: SiC CERAMICS Abstract Only
G. A. Gogotai, G. G. Gnesin, Ya. L. Grushevskiy, and V. P. Zavada *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 24 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 77-80 Original language document was announced in IAA as A87-43641 (For primary document see N88-22988 16-27)
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The mechanical characteristics of a silicon carbide ceramic were investigated experimentally in the temperature range of 20 to 1400 C. It was found that the ultimate tensile strength of the ceramic (170 MPa) is maintained in the temperature range of 20 to 1200 C but decreased at higher temperatures. At 1400 C, the strength of the ceramic was only 43 MPa. It was also found that the critical stress intensity factor increases with temperature, which is explained by the softening of the silicon phase in the material. E.R.

N88-22995 Joint Publications Research Service, Arlington, Va.
STRENGTH AND FAILURE RATE OF COMPOSITE MATERIALS WITH CARBON IN CERAMIC MATRIX Abstract Only **c24**
E. A. Eskin, G. P. Khristov, A. S. Petrov, V. K. Fedchuk, and A. V. Izotov *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 24-25 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 80-84 Original language document was announced in IAA as A87-43642 (For primary document see N88-22988 16-27)
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An experimental study was made of the effect of a high temperature oxidizing medium on the load bearing capacity of ceramic matrix composites reinforced by carbon fabric with and without a heat resistant coating. Changes in the load bearing capacity, strength, and damage of the materials tested are related to the time of exposure to the high temperature oxidizing medium. It was shown that oxidation starts with the carbon fibers and that there is a linear relationship between the thickness of the oxidized layer and the heating time. E.R.

N88-22996 Joint Publications Research Service, Arlington, Va.
HIGH-STRENGTH CERAMIC BASED ON TETRAGONAL ZrO2 WITH Al2O3 ADMIXTURE Abstract Only
S. Yu. Pliner, Yu. I. Komolikov, V. G. Peychev, M. V. Safronov, and A. A. Dabizha *In its* JPRS Report: Science and Technology.

USSR: Materials Science 17 Mar. 1988 p 32 Transl. into ENGLISH from Ogneupory (Moscow, USSR), no. 4, Apr. 1987 p 27-29 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

A feasibility study of producing high strength ZrO2(Y2O3)Al2O3 ceramic was made, considering that the Y3Al5O12 garnet crystals which form along with the solid solution of these 3 oxides inhibit compaction during sintering. Mixing powder of tetragonal ZrO2 and alpha-Al2O3 powder in aqueous suspensions was tried as a way to help sintering under high pressure. ZrO2 + 5 percent Y2O3 powder and alpha-Al2O3 powder in stable suspensions were mixed in a rotating polyethylene drum, with the alpha-Al2O3 content varied up to 60 wt percent. Ingots produced by casting into gypsum molds were annealed in air inside an electric furnace at temperatures of 1400 to 1550 C. Subsequent mechanical tests for flexural strength by the 3 point method at room temperature have revealed that high strength ceramic can be produced only with an alpha-Al2O3 content not higher than 25 wt percent. Phase analysis in a DRON1-UM X-ray diffractometer indicates that a higher alpha-Al2O3 evidently transform the structure from a ZrO2 matrix with isolated alpha-Al2O3 grains into two continuous phases: alpha-Al2O3 with isolated ZrO2 grains and ZrO2 with isolated alpha-Al2O3 grains. Author

N88-22997# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
CORRELATION BETWEEN DIELECTRIC AND STRUCTURAL PROPERTIES DURING EPOXY CURE Technical Report No. 10, Oct. 1986 - Oct. 1987
Wayne W. Bidstrup, Sue A. Bidstrup, and Stephen D. Senturia 1 Nov. 1987 17 p
(Contract N00014-84-K-0274)
(AD-A190696) Avail: NTIS HC A03/MF A01 CSCL 11I

The relationship between the dielectric properties and the molecular structure of a commercial epoxy resin, Ciba-Geigy's MY720, is reported. The ionic conductivity sigma was measured at several temperatures by microdielectrometry and correlated with the structural parameter, the glass transition temperature Tg, through a modified Williams Landel Ferry formulation where C1 is a constant and C2 and log sigma(Tg) are assumed to be a linear functions of Tg. GRA

N88-22998# Brown, Boveri und Cie, A.G., Mannheim (West Germany). Zentrales Labor fuer Werkstofftechnik.
EVALUATION OF CERAMIC THERMAL BARRIER COATINGS FOR GAS TURBINE ENGINE COMPONENTS European Concerted Action. COST 501-D28 Final Report, Jan. 1983 - Dec. 1985
Ralf Buergel, Klays Schneider, and Beate Trueck Aug. 1986 53 p
(ETN-88-91947) Avail: NTIS HC A04/MF A01

Duplex thermal barrier systems were assessed under test conditions relevant for stationary gas turbines including thermal cycling, cyclic oxidation, and hot corrosion. Attention is focused on ZrO2 -7/8 wt percent Y2O3 ceramic systems that prove to be most durable for turbine applications. The test results reveal that thermal barrier systems are available which are sufficiently thermal cyclic resistant. Oxidation of the metallic bond coat is identified as the life-limiting process while hot corrosion is less of a problem at high temperatures (950 C or above). An approach to overcome early degradation of the bond coat is to apply layers with few processing defects, i.e., to replace air plasma spraying of metallic coats by vacuum chamber spraying or inert gas shroud spraying wherever it is technically feasible. ESA

N88-22999# Technische Hogeschool, Eindhoven (Netherlands).
THE MECHANICAL BEHAVIOR OF PARTICLE FILLED THERMOPLASTICS Ph.D. Thesis
Peter Hendrikus Theo Vollenberg 1987 128 p
(ETN-88-92234) Avail: NTIS HC A07/MF A01

The effects of a variation of the particle size of the filler, filler content, shape of the filler particles, and interfacial adhesion on the properties of four different thermoplastics were examined. The mechanical properties of chalk filled polypropylene; dewetting stress of glass bead filled polystyrene and polypropylene; dewetting stress of polystyrene filled with irregularly shaped chalk particles; dewetting stress of polystyrene filled with submicron titanium-dioxide particles; particle size dependence of the Young's modulus of filled polymers; particle size dependence of the elastic modulus of filled polymers; and the ultimate properties of glass bead filled styrene acrylonitrile polymer are discussed. ESA

N88-23000 National Bureau of Standards, Gaithersburg, Md.
PROTECTIVE COATINGS ON METALS, VOLUME 10
G. V. Samsonov, ed. 1987 207 p Transl. into ENGLISH of Zashchitnye Pokrytiya na Metallakh, Vyp. 10 (Kiev, USSR, Naukova Dumka), 1976 204 p
(PB88-174461; TT-79-52016) Copyright Avail: Issuing Activity CSCL 11C

The general and theoretical problems of diffusion impregnation and formation of coatings; the technology of applying single and multicomponent diffusion, plasma and other kinds of coatings; and use of the properties of metals and alloys with protective coatings are discussed. Author

N88-23001# Swedish Inst. for Materials Testing, Boras.
SMALL-SCALE CLEAVAGE TEST OF POLYMER PRODUCTS
Janos Hetenyi and Conny Lagerquist Jun. 1987 23 p
(PB88-165360; SP-RAPP-1987:22; ISBB-91-7848-064-7) Avail: NTIS HC A03/MF A01 CSCL 11B

The mechanical cleavage test for characterization of polymers is discussed. It serves as a reliable guide in the selection of material, semi-finished and finished products, and applications. These tests also have the advantage of clearly indicating the obvious weak points in any initial design. The data can then also be used to indicate the most likely modification that will result in optimum performance. Some results of the cleavage-test are contained. GRA

N88-23002# Lawrence Livermore National Lab., Calif.
FRACTURE MORPHOLOGIES OF CARBON-BLACK-LOADED SBR (STYRENE-BUTADIENE RUBBER) SUBJECTED TO LOW-CYCLE, HIGH-STRESS FATIGUE
Alfred Goldberg, Donald R. Lesuer, and Jacob Patt (Army Tank-Automotive Command, Warren, Mich.) 1 Feb. 1988 26 p Presented at the Severe Environment Symposium, Dallas, Tex., 19 Apr. 1988
(Contract W-7405-eng-48)
(DE88-006808; UCRL-97913; CONF-880480-1) Avail: NTIS HC A03/MF A01

Experimental results, together with an analytical model, related to the loss in tensile strength of styrene-butadiene rubber (SBR) loaded with carbon black (CB) that had been subjected to low-cycle, high-stress fatigue tests were presented in a prior paper. The drop in tensile strength relative to that of a virgin sample was considered to be a measure of damage induced during the fatigue test. The present paper is a continuation of this study dealing with the morphological interpretations of the fractured surfaces, whereby the cyclic-tearing behavior, resulting in the damage, is related to the test and material parameters. It was found that failure is almost always initiated in the bulk of a sample at a material flaw. The size and definition of a flaw increase with an increase in carbon-black loading. Initiation flaw sites are enveloped by fan-shaped or penny-shaped regions which develop during cycling. The size and morphology of a fatigue-tear region appears to be independent of the fatigue load or the extent of the damage (strength loss). By contrast, either an increase in cycling load or an increase in damage at constant load increases the definition of the fatigue-region morphology for all formulations of carbon-black. On the finest scale, the morphology can be described in terms of tearing of individual groups of rubber strands, collapsing to form a cell-like structure. DOE

N88-23003*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EVALUATION OF A THERMOPLASTIC POLYIMIDE (422) FOR BONDING GR/PI COMPOSITE
Donald J. Progar Apr. 1988 28 p
(NASA-TM-100584; NAS 1.15:100584) Avail: NTIS HC A03/MF A01 CSCL 11B

A hot-melt processable copolyimide previously studied and characterized as an adhesive for bonding Ti-6Al-4V was used to bond Celion 6000/LARC-160 composite. Comparisons are made for the two adherend systems. A bonding cycle was determined for the composite bonding and lap shear specimens were prepared which were thermally exposed in a forced-air oven for up to 5000 h at 204 C. The lap shear strengths (LSSs) were determined at RT, 177, and 204 C. After thermal exposure at RT, 177, and 204 C the LSS decreased significantly; however, a slight increase was noted for the 204 C tests. Initially the LSS values are higher for the bonded Ti-6Al-4V than for the bonded composite, however, the LSS decreases dramatically between 5000 and 10,000 h of 204 C thermal exposure. Longer periods of thermal exposure up to 20,000 h results in further decreases in the LSSs. Although the bonded composite retained useful strengths for exposures up to 5000 h, based on the poor results of the bonded Ti-6Al-4V beyond 5000 h, the 422 adhesive bonded composites would most likely also produce poor strengths beyond 5000 h exposure. Adhesive bonded composite lap shear specimens exposed to boiling water for 72 h exhibited greatly reduced strengths at all test temperatures. The percent retained after water boil for each test temperature was essentially the same for both systems. Author

N88-23004# Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Mechanical Engineering.
HIGH TEMPERATURE SOLID LUBRICATION BY CATALYTICALLY GENERATED CARBON
James L. Lauer and Bruce G. Bunting 1987 13 p Presented at the STLE/ASME Tribology Conference, San Antonio, Tex., 5-8 Oct. 1987
(Contracts DAAL03-86-K-0076; DAAL03-86-G-0042)
(AD-A190804; ARO-23525.10-EG) Avail: NTIS HC A03/MF A01 CSCL 11H

The wear process in bearings generates a clean active surface. Carbon is known to form readily on catalytic surfaces through the reduction of carbon oxides or hydrocarbon. Carbon, through the adsorption of hydrocarbons, water vapor, or oxygen, becomes an effective lubricant. If these three phenomena can be made to work together, a new concept of high temperature lubrication would be available. This paper presents laboratory investigations towards the development of this concept. Carbon has been successfully produced through catalytic reduction of ethylene on a variety of metallic and ceramic surfaces containing nickel. This carbon has been shown to reduce friction at a sliding interface at elevated temperatures. GRA

N88-23005# Hughes Research Labs., Malibu, Calif. Exploratories Studies Dept.
APPLICATIONS RESEARCH STUDIES OF MICROTUBULES Monthly Letter Progress Report No. 3, 12 Oct. - 13 Nov. 1987
J. D. Margerum 20 Nov. 1987 5 p
(Contract N00014-87-C-2354)
(AD-A190855) Avail: NTIS HC A02/MF A01 CSCL 20F

This contract provides the Hughes Research Laboratories (HRL) funding for the first year of a three year research program to investigate techniques basic to novel applications of lipid microtubules for electro-optical, optical, and sensor devices, and to study the feasibility of such device applications. The overall program has two main area: (1) the study of ordered microtubules in fluids and films, for applications such as variable transmission windows, IR polarizers, and dichroic filters; and (2) the study of ordered attachment of microtubules to surfaces, for applications such as nonlinear optical devices and acoustic detectors. The emphasis in this first year is on the suspension, orientation and electro-optical properties of microtubules in fluids, liquid crystals, and polymers, and on techniques for controlling the orientation and attachment of microtubules to surfaces. GRA

N88-23006# Princeton Univ., N. J. Dept. of Chemical Engineering.
THE TIME-TEMPERATURE-TRANSFORMATION (TTT) DIAGRAM AS A BASIS FOR RELATING THE FORMATION AND PROPERTIES OF REACTIVE COATINGS Technical Report No. 13, 31 Jan. 1987 - 31 Jan. 1988
John K. Gillham Jan. 1988 25 p
(Contract N00014-84-K-0021)
(AD-A190872; TR-13) Avail: NTIS HC A03/MF A01 CSCL 07F

A review of research in the author's laboratory is presented. Interrelationships between reaction conditions and material properties of thermosetting and high Tg polymers are discussed from the point of view of generalized time-temperature-transformation (TTT) diagram. The TBA torsion pendulum is discussed as a technique for characterizing reactive coatings. GRA

N88-23007# Massachusetts Inst. of Tech., Cambridge. Dept. of Chemical Engineering.
DISTRIBUTION OF CHAIN ENDS INSIDE THE POLYBUTADIENE MICROSPHERES OF SB DIBLOCK COPOLYMERS
P. Cheng, C. V. Berney, and R. E. Cohen 28 Jan. 1988 21 p
(Contract N00014-87-K-0517)
(AD-A191257; TR-2) Avail: NTIS HC A03/MF A01 CSCL 07F

Two polystyrene polybutadiene block copolymers were examined in small angle neutron scattering (SANS) experiments designed to probe the location of the polybutadiene chain ends inside the polybutadiene microspheres of these specimens. One of the copolymers, SBm, was phase-matched; the B moiety was synthesized using a suitable mixture of deutero and normal butadiene monomer. The other copolymer, SBmBd, contained short perdeuterated polybutadiene sequences at the end of the polybutadiene block of each of the molecules. Consideration of scattering intensities and the form of the scattering pattern exhibited by SBmBd indicated that the Bd chain ends are essentially uniformly distributed throughout the volume of the spheres. A model in which the Bd ends cluster at the core of the spheres failed to reproduce the essential features of the observed SANS pattern. GRA

N88-23008# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
ELECTRICAL dc CONDUCTIVITY OF PITCH
Phillip I. Gold 30 Oct. 1987 25 p
(Contract F04701-85-C-0086)
(AD-A191266; TR-0086A(2935-06)-1; SD-TR-87-58) Avail: NTIS HC A02/MF A01 CSCL 20C

Untreated A240 pitch was thermally cycled to 450 C at rates of 5 C/min, 1 C/min, and 5 C/hr. The electric (d.c.) conductivity measured during both heating and cooling portions of the cycle displayed a hysteresis effect resulting from volatilization of lower molecular weight components, polymerization, and mesophase formation. The heating curve obeyed an Arrhenius relation at low temperatures below the onset of significant volatilization, while the cooling curve was observed to follow an Arrhenius relation at all temperatures. GRA

N88-23009# Naval Air Development Center, Warminster, Pa. Air Vehicle and Crew Systems Technology Directorate.
DEVELOPMENT OF A HIGH-TEMPERATURE RESISTANT (700 F), CORROSION-PREVENTIVE ORGANIC COATING Final Report, Oct. 1984 - Sep. 1986
Stephen J. Spadafora 11 Jul. 1987 41 p Original contains color illustrations
(AD-A191407; NADC-87171-60) Avail: NTIS HC A03/MF A01 CSCL 11C

Current materials used in this temperature range (700 F) have significant deficiencies. Ceramic coatings provide good protection,

but are difficult to apply and require a high-temperature cure. Standard paints can be easily applied and air dry, but they provide poor protection against corrosion. While materials requiring high-temperature cure and special application equipment can be used in manufacturing processes, they are not practical for most aircraft repair and touchup applications. Therefore, for these applications, the air-dry systems are primarily used. These systems provide barrier protection against the environment. GRA

N88-23010# Purdue Univ., West Lafayette, Ind. Dept. of Chemistry.
FAST ION CONDUCTING GLASSES Report, 1 Oct. 1986 - 30 Sep. 1987
C. A. Angell Oct. 1987 6 p
(Contract N00014-84-K-0289)
(AD-A191412) Avail: NTIS HC A02/MF A01 CSCL 11B

The focus of this research was on fast ion conduction in amorphous materials. Early work concentrated on silver and copper ion containing systems. Since then the program has broadened to include the study of the kinetic processes which determine whether or not an amorphous solid is formed during the cooling of an ionic liquid. Another new development was the introduction of the pressure variable. Initially this was intended to determine whether conductivity of glasses could be increased by compaction under pressure. However, this work branched into a study of the effect of pressure on elastomer ion systems (ion-polymer solutions) to check a possibility we raised in a plenary lecture in 1983, viz., that ion pair dissociation (which was suspected of limiting the conductivity of these systems) could be enhanced and conductivity thereby increased. GRA

N88-23019# Joint Publications Research Service, Arlington, Va.
GOVERNMENT RESEARCH ON CERAMICS COATING TECHNOLOGY
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 1-8 Transl. into ENGLISH from Kogyo Zairyo (Tokyo, Japan), Jul. 1987 p 33-37 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-23011# Sun Refining and Marketing Co., Marcus Hooks, Pa. Applied Research and Development Dept.
TURBINE FUELS FROM TAR SANDS BITUMEN AND HEAVY OIL. VOLUME 2, PHASE 3: PROCESS DESIGN SPECIFICATIONS FOR A TURBINE FUEL REFINERY CHARGING SAN ARDO HEAVY CRUDE OIL Final Report, 1 Jun. 1985 - 31 Mar. 1987
A. F. Talbot, J. R. Swesey, and L. G. Magill Sep. 1987 247 p
(Contract F33615-83-C-2352)
(AD-A190120; AFWAL-TR-87-2043-Vol-2) Avail: NTIS HC A11/MF A01 CSCL 21D

An engineering design was developed for a 50,000 BPSD grass-roots refinery to produce aviation turbine fuel grades JP-4 and JP-8 from San Ardo heavy crude oil. The design was based on the pilot plant studies described in Phase 3 - Volume 1 of this report. The detailed plant design described in this report was used to determine estimated production costs. GRA

N88-23012# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
THE EFFECT OF WEATHERING ON OCTANE QUALITY FOR WINTER-GRADE AND SUMMER-GRADE GASOLINES Final Report
Richard N. Wares Dec. 1987 84 p
(Contract DE-FC22-83FE-60149)
(AD-A190640; DOT/FAA/CT-87/16) Avail: NTIS HC A05/MF A01 CSCL 21D

Weathering tests were conducted to examine the effects on fuel volatility and octane characteristics. The commercially available gasolines utilized in the study represented a wide geographic distribution for both winter and summer fuels. Aging was accomplished by heating the fuel samples to 110 degrees F and maintaining that temperature for 48 hours. Time histories of Reid Vapor Pressure (RFP) were conducted. Fuel octane evaluations, both MON and RON, were done. Component characterization by gas chromatography were made to identify components lost during the aging process. The time histories of vapor pressure changes depended to a limited measure on the initial fuel vapor pressure as well as to differences in composition. Butanes and isopentanes were the primary constituents lost due to the weathering. For the most part octane changes due to fuel weathering were minimal. GRA

N88-23013# IIT Research Inst., Bartlesville, Okla. National Inst. for Petroleum and Energy Research.
RECLAMATION OF WATER CONTAMINATED WITH FUEL SYSTEM ICING INHIBITOR. PHASE 1: LITERATURE REVIEW AND INFORMATION COMPILATION
D. W. Brinkman, K. Q. Stirling, M. L. Whisman, and O. K. Bhan Feb. 1988 101 p Sponsored in part by Defense Fuel Supply Center, Alexandria, Va.
(Contract DE-FC22-83FE-60149)
(DE88-006575; NIPER-330) Avail: NTIS HC A06/MF A01

The volume of water that must be removed from an aviation turbine fuel storage tank can be as much as 15,000 to 20,000 gallons per year from a fuel tank of moderate capacity. If each fuel storage facility has 10 fuel storage tanks, a total water volume of 200,000 gallons per terminal per year is a reasonable estimate. Some terminals generate as much as one million gallons per year of FSII contaminated wastewater. In the past, this FSII/water mixture was released from time to time into diked areas around the storage tank where it evaporated or penetrated underlying media. A host of recent studies that have shown these glycol ethers to be toxic now make this practice questionable based on both vapor inhalation toxicity and potential groundwater contamination. The ensuing narrative sections contain a summary of the data and information that have been compiled as a result of computerized literature searches, personal contacts with government and industry representatives knowledgeable in the field of FSII, and contact with vendors of equipment and processes with some applicability to achieving the goals of this research. Our recommendations for the subsequent bench-scale testing phase are included and are based upon this literature compilation and review. If the second phase yields a technically and economically attractive solution, a third phase will follow to implement concept verification studies. DOE

N88-23014# Naval Surface Weapons Center, Silver Spring, Md.
STATIC DIELECTRIC BREAKDOWN STRENGTH OF CONDENSED HETEROGENEOUS HIGH EXPLOSIVES Report, Oct. 1984 - Sep. 1985
R. J. Lee Jun. 1987 61 p
(AD-A191035; NSWC/TR-85-380) Avail: NTIS HC A04/MF A01 CSCL 19A

A new method of obtaining static dielectric breakdown strength data is reported. The breakdown strengths of plastic bonded explosives have been obtained using this method. The theory of dielectric breakdown in solid materials, including explosives, is presented. The difficulties associated with the measurement of dielectric breakdown strengths are then analyzed in detail, and using this analysis, a new test method is described. GRA

N88-23015# Coordinating Research Council, Inc., Atlanta, Ga.
DEVELOPMENT OF A LABORATORY TEST FOR MULTIPORT FUEL INJECTOR DEPOSITS - EVALUATION OF THE JET FUEL THERMAL OXIDATION TEST APPARATUS (JFTOT) Final Report

Harold O. Strange Dec. 1987 39 p Prepared in cooperation with Pittsburgh Univ., Pa.
(Contract DAAK70-86-C-0011)
(AD-A191313) Avail: NTIS HC A03/MF A01 CSCL 21D

This report describes the laboratory effort to develop a bench test suitable for screening gasolines to determine their potential for forming deposits in automative port fuel injectors. The test selected for this work was the Jet Fuel Thermal Oxidation Test (JFTOT) method described in ASTM D 3241. Tests were conducted at various temperatures and operating conditions on two base gasolines having low and high deposit forming tendency in vehicle tests. In addition, tests were also run on a commercial unleaded gasoline containing detergent additives and on the high deposition fuel treated with varying dosages of four additives claimed to be effective in preventing port fuel injector deposits in vehicle tests.
GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

N88-23016# Freiburg Univ. (West Germany). Inst. fuer Kristallographie.
ZONE CRYSTALLIZATION EXPERIMENTS IN MIRROR HEATING FACILITIES Final Report, Dec. 1985
Martin Bruder, Arne Croell, Achim Eyer, Harald Leiste, Wolfgang Mueller, and Ursula Probst Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 227 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany
(BMFT-FB-W-86-023; ISSN-0170-1339; ETN-88-92331)
Copyright Avail: NTIS HC A11/MF A01;
Fachinformationszentrum Karlsruhe, 7514
Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 39 DM + MWST

Five crystal growth experiments on Spacelab (FSLP and D1-mission) and sounding rockets (TEXUS 7 and TEXUS 12) are reported. Three silicon crystals, float-zoned during the TEXUS 7, TEXUS 12, and FSLP missions were investigated by evaluating structural defects and dopant striations. Marangoni convection is recognized as the cause of the striated dopant segregation in float-zoned silicon. As a consequence of the experiments, a method which eliminates Marangoni-convection by surface coating the melt with a silica film was developed. The preparation and performance of crystal growth experiments (floating-zone of Si and vapor growth of CdTe) on the D1-mission are reported. The preparation of vapor growth experiments of 2 to 6-compounds for the EURECA-mission is described.
ESA

N88-23017# Fraunhofer-Inst. fuer Grenzflaechen- und Bioverfahrenstechnik, Stuttgart (West Germany).
GENERATION AND COALESCENCE OF BUBBLES AND STABILITY OF FOAMS UNDER MICROGRAVITY CONDITIONS Final Report, Oct. 1984
Karl-Friedrich Gebhardt, Dieter Renzow, and Peter-Juergen Sell Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 119 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany
(BMFT-FB-W-86-020; ISSN-0340-7608; ETN-88-92330) Avail: NTIS HC A06/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 25 DM + MWST

The transition form spherical foams to polyeder foams was investigated under reduced gravity. In four cells with different aqueous SDS solutions bubbles were formed by a gas jet. By reducing the liquid, the bubbles were forced to touch and finally form a polyeder foam. Earth bound simulation experiments were performed and foam stability and dynamical surface properties determined. A TEXUS sounding rocket experiment shows that under reduced gravity bubbles leave the nozzle relatively easily and a polyeder foam can be reversed to a spherical foam. The latter observation sheds light on the role of the plateau-border. The plateau-border sucks liquid from the reservoir into the foam and lamellae, if outer forces as gravity or artificial low pressure are reduced in order to change a polyeder foam into a spehrical foam.
ESA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-23018# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. JAPAN
11 Sep. 1987 76 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-87-026) Avail: NTIS HC A05/MF A01

Topics addressed include: biotechnology; microelectronics; ceramics; energy technology; transportation; and industrial technology. For individual titles, see N88-23019 through N88-23025.

N88-23019# Joint Publications Research Service, Arlington, Va.
GOVERNMENT RESEARCH ON CERAMICS COATING TECHNOLOGY **c27**
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 1-8 Transl. into ENGLISH from Kogyo Zairyo (Tokyo, Japan), Jul. 1987 p 33-37 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

Research on fine ceramics is outlined. Also discussed are: leading edge processing systems; atomic power equipment; incinerators; plasma spraying technology; and ceramic painting.
B.G.

N88-23020# Joint Publications Research Service, Arlington, Va.
FRENCH EVALUATION OF JAPANESE BIOSENSORS **c35**
Silvia Vaisman *In its* JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 9-15 Transl. into ENGLISH from Biofutur (Paris, France) Feb. 1987 p 64-65, 67 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

The market for biosensors is in its infancy. The major attractions of these measurement instruments are: their specificity, high degree of sensitivity, possibility of producing them in miniature and automated form, and their rapid detection speed. Biomedical and industrial applications are discussed. Also examined is the area of environmental monitoring.
B.G.

N88-23021# Joint Publications Research Service, Arlington, Va.
SUNSHINE PROJECT FOR FY 1987 OUTLINED **c44**
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 16-28 Transl. into ENGLISH from Jita Nyusu (Tokyo, Japan), Apr. 1987 p 5-10 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

The Sunshine Project was launched in FY 1974 with the objective of planning the improvement of Japan's fragile energy supply structure through the development of energy technologies. Today the basic research stage of the principal projects is completed and progress has reached to the plant development stage. Research and development projects are summarized.
B.G.

N88-23022# Joint Publications Research Service, Arlington, Va.
STATUS OF CAD/CAM IN MEDIUM-SIZED INDUSTRIES DESCRIBED **c61**
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 29-43 Transl. into ENGLISH from Kakai To Kogu (Tokyo, Japan), Jun. 1987 p 113-119 (For primary document

see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

Computer aided design (CAD) and computer aided manufacturing (CAM) which further design and production by computer support, are noteworthy as the central technology in the manufacturing industry. The most important point in the introduction of systems into small and medium-sized businesses will be the amount of investment. As with numerical control (NC) equipment and industrial robots, systems will be put into practice even at a relatively high cost, as long as the object of the investment is a machine that will produce added value directly. However, the present situation with CAD/CAM is such that even though an effective introduction of the equipment and a raising of the technological level within the company can be predicted, a sufficient profit cannot be guaranteed. The Tokyo Municipal Industrial Technology Center, from July through September of last year, conducted a survey involving small and medium-sized firms within the city and CAD, CAM, and computer graphics (CG), along with the production technologies connected with them. The survey analyzed the needs of the firms and their trends. Author

N88-23023# Joint Publications Research Service, Arlington, Va.
HIGH-SPEED ELECTRON BEAM LITHOGRAPHY DEVICES DISCUSSED **c76**
Yuuta Sagara *In its* JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 44-46 Transl. into ENGLISH from Toshi Keizai (Tokyo, Japan), Sep. 1986 p 40-41 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

With the upgrading and advanced integration of semiconductor device functions, high-speed electron-beam lithography equipment is attracting attention because it can draw LSI patterns as small as 0.5 to 0.1 micron directly on a wafer at high speed. Research and development of the electron-beam lithography equipment is proceeding from the following two angles: the minimum pattern size is limited to about 0.5 micron, and ultramicroscopic patterns of 0.1 micron or less can be drawn. Research in this area is briefly summarized. B.G.

N88-23024# Joint Publications Research Service, Arlington, Va.
PRESENT, FUTURE OF AUTOMOTIVE HYBRID IC APPLICATIONS DISCUSSED **c33**
Nobuyoshi Matsuda and Atuhisa Fukuoka *In its* JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 47-59 Transl. into ENGLISH from Jidoshi Gijutsu (Tokyo, Japan), Feb. 1987 p 195-201 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

Hybrid ICs are presently utilized in various fields such as commercial televisions, VTRs, and audio devices, industrial usage of communication equipment, computers, terminals, and automobiles. Its applications and environments are various and diverse. The functions required for hybrid ICs vary from simple high density mounting for a system to the realization of high mechanisms with the application of function timing. The functions are properly used depending upon the system with its hybrid ICs and its circuit composition. Considering structure and reliability requirements for automotive hybrid ICs, an application example for hybrid ICs which use the package (COMPACT), will be discussed. Author

N88-23025# Joint Publications Research Service, Arlington, Va.
FULL ELECTRONIC CONTROL SYSTEM FOR DIESEL ENGINE **c37**
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 60-73 Transl. into ENGLISH from Jidosha Gijutsu (Tokyo, Japan), Feb. 1987 p 248-254 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

The engine control of an automobile with the application of a microcomputer has made major advances since its introduction. Isuzu Motor Co., Ltd., developed the Isuzu Economy (IE) system which controls the amount of fuel injected and the injection timing. The 67SD1-TC model engine installed in the model 810 super had added not only the control of the amount of fuel injected and the injection timing systems, but also the variable swirl system which electronically controls a swirl ratio of intake air, and the variable capacity turbo system which gives the electronic control of turbo capacity as well. This system was constructed as the synthetic electronic control system for the engine and is summarized. Author

N88-23026# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. JAPAN
12 Nov. 1987 94 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-87-030) Avail: NTIS HC A05/MF A01

Topics addressed included: nuclear developments; aerospace engineering; automotive industry; feedback lasers; and science and technology policy. For individual titles, see N88-23027 through N88-23028.

N88-23027# Joint Publications Research Service, Arlington, Va.
STATUS, TRENDS IN RESEARCH ON INTERNAL COMBUSTION ENGINES **c37**
Shoichi Furuhama *In its* JPRS Report: Science and Technology. Japan 12 Nov. 1987 p 2-26 Transl. into ENGLISH from Nainen Kikan (Tokyo, Japan), Jun. 1987 p 9-19 (For primary document see N88-23026 16-31)
Avail: NTIS HC A05/MF A01

In Japan, a K.K. New Combustion System Research Institute headed by Takashi Suzuki as president, was established as a think-tank company with the support, mainly, of the nation's diesel vehicle manufacturers. The reported purpose is to study the conceptional engine during a 6 year period, hopefully expecting to achieve great results. A portion from some recent papers is presented which deal chiefly with diesel engines, seeking trends for the future. Author

N88-23028# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF DISTRIBUTED FEEDBACK LASERS DISCUSSED **c36**
In its JPRS Report: Science and Technology. Japan 12 Nov. 1987 p 27-31 Transl. into ENGLISH from Boei Gijutsu (Tokyo, Japan), Apr. 1987 p 53-56 (For primary document see N88-23026 16-31)
Avail: NTIS HC A05/MF A01

By putting the Distributed Feedback (DFB) laser in a single spectrum to practical use, a significant expansion of the transmission band and transmission distance in optical communication will become possible. Although there is insufficient extended use data to assess the reliability of the DFB laser, the 1.3 and 1.5 micron DFB lasers are thought to have a reliability almost equivalent to the several thousand hour reliability of the Fabry Perot (FP) laser, and in the future they will probably be used widely in long-distance optical communications, taking the place of the 1.3 micron band FP laser. Author

N88-23029# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. d'Etude des Procedes de Fabrication.
CONTRIBUTION TO THE STUDY OF MODERN MATERIALS FOR CUTTING TOOLS Ph.D. Thesis [CONTRIBUTION A L ETUDE DU COMPORTEMENT DES MATERIAUX MODERNES POUR OUTILS COUPANTS]
Boudjemaa Amri 1987 148 p In FRENCH
(ISAL-IDI1-87-17; ETN-88-92012) Avail: NTIS HC A07/MF A01

Cutting tool degradation modes are described and their influence on processing mechanical parameters is discussed. A method to determine the cutting capacity from accelerated tests is described. The design of a study to determine the temperature distribution in the cutting zone using the finite element method is presented. It is shown that the ISO degradation criteria derived from tungsten carbide tools tests is not directly applicable to modern materials, especially when the wearing process is not continuous. ESA

N88-23030# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
3 May 1988 171 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-88-009) Avail: NTIS HC A08/MF A01

Articles from the open literature are presented in the areas of aerospace science, applied sciences, earth sciences, environmental quality, life sciences, and national developments. For individual titles, see N88-23031 through N88-23035.

N88-23031# Joint Publications Research Service, Arlington, Va.
AIRCRAFT FLIGHT DYNAMICS RESEARCH IN PAST DECADE REVIEWED **c05**
Liqin Fan and Qishun Chen *In its* JPRS Report: Science and Technology. China 3 May 1988 p 1-8 Transl. into ENGLISH from Guoji Hangkong (Beijing, People's Republic of China), no. 2, Feb. 1988 p 28-31 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

Chinese research over the past decade in flight dynamics is reviewed. Areas discussed include research in aircraft flight quality specifications and flight performance specifications, controllable flight dynamics, atmospheric disturbance, study of non-linear characteristics, and development of test research methods. J.P.B.

N88-23032# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT OF FAST BREEDER REACTORS IN CHINA **c73**
Shounan Li *In its* JPRS Report: Science and Technology. China 3 May 1988 p 20-35 Transl. into ENGLISH from Wuli (Beijing, People's Republic of China), v. 16, no. 8, Aug. 1987 p 460; 487-493 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

The principle of a fusion-fission hybrid nuclear reactor is described. The nuclear physics foundation of the hybrid reactor is outlined. Two types of hybrid reactors--fission and retarded fission reactors--are described. The means by which hybrid reactors can advance the use of fusion energy are set forth. Two types of breeder reactors are described: fusion and fission breeder reactors. A case is made that hybrid reactor breeder energy is much greater than that of fast reactors, and that the hybrid reactor is not inhibited by industrial plutonium. It is further maintained that the price of electric energy of the hybrid reactor-pressure water reactor co-generation system is cheaper than that of the fast reactor-pressure water reactor co-generation system; that hybride reactor-LWR co-generation systems consume less uranium than fast reactor systems; that a Th/U system hybrid reactor-LWR co-generation system is economical in the use of thorium resources; and that hybrid reactors are safer than fast reactors. J.P.B.

N88-23033# Joint Publications Research Service, Arlington, Va.
DESIGN OF NUCLEAR HEAT, POWER CO-GENERATION PLANT DETAILED **c73**
Jukui Liu *In its* JPRS Report: Science and Technology. China 3 May 1988 p 36-55 Transl. into ENGLISH from He Dongli Gongcheng (Chengdu, People's Republic of China), v. 8, no. 6, Dec. 1987 p 1-13 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

A nuclear cogenerating plant with the following characteristics is described: low capital requirement, short construction time, high reliability, safety, and simplicity. A primary process flowchart is given for such a plant, and the reactor design is detailed. The following subsystems are described and diagrammed: primary loop auxiliary system, intermediate loop and auxiliary system, pressure safety system, purification system, and reactor building and nuclear annex. A preliminary analysis is made of total investment, replacement of oil consumption, and economic benefit. J.P.B.

N88-23034# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL INVESTIGATION ON STIMULATED RAMAN SCATTERING IN HIGH-PRESSURE HYDROGEN BY RUBY LASER **c74**
Guangqiu Zhang, Junyong Xiao, and Jichun Ma *In its* JPRS Report: Science and Technology. China 3 May 1988 p 76-82 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 7, no. 5, Oct. 1987 p 217-220 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

A system is described for observing stimulated Raman phenomena and experimental results are described. The laser energy threshold for producing stimulated Raman scattering and the transfer efficiency of each level of scattered light were measured. The results showed that stimulated Raman scattering is a parameter process involving the interaction of multiple waves. Author

N88-23035# Joint Publications Research Service, Arlington, Va.
PROPAGATION OF ACOUSTIC GRAVITY WAVE SPECTRUM THROUGH VERTICAL WIND SHEAR REGION Abstract Only **c46**
Fan Yi, Baixian Liang, and Jun Li *In its* JPRS Report: Science and Technology. China 3 May 1988 p 127 Transl. into ENGLISH from Diqiu Wuli Xuebao (Beijing, People's Republic of China), v. 31, no. 1, Jan. 1988 p 1-9 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

The variation in spectral structures of acoustic gravity waves (AGWs) propagating through a vertical wind shear region is investigated. Using the compressible hydrodynamic equations, a spectral equation describing the propagation of AGWs in a vertical wind shear region is derived. It is pointed out that the spectral equation is a generalized form of the Taylor-Goldstein equation for the case of compressible medium and arbitrary vertical wavelength. Starting from the spectral equation, considering an AGW force with a two-dimensional Gaussian spectrum at its lower boundary and by using a differential method, the AGW spectrum at a higher level is calculated. It is shown that under the influence of the vertical wind shear, the AGW's spectral structure is considerably changed as follows: (1) some spectral components in the forcing spectrum are filtered off and, therefore, several sharp spectral peaks occur; (2) the main peak moves in a frequency-wave number space; and (3) the spectrum at a higher level becomes narrower. These calculated results may explain some of the phenomena observed in the ionosphere. Author

N88-23036# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. CHINA
14 Jan. 1988 128 p Transl. into ENGLISH from various Chinese articles
(JPRS-CST-88-001) Avail: NTIS HC A07/MF A01

Articles and summaries from the open literature are presented in the areas of applied sciences, environmental quality, life sciences, national developments, and scientists and scientific organizations. For individual titles, see N88-23037 through N88-23042.

N88-23037# Joint Publications Research Service, Arlington, Va.
NUMERICAL ANALYSIS OF CRITICAL PENETRATION VELOCITY FOR JET PERPENDICULAR PENETRATION **c34**
Mengzhao Qin, Chunsheng Xie, Qingming Tan, and Xiaoping Liu *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 8-20 Transl. into ENGLISH from Lixue Xuebao (Beijing, People's Republic of China), v. 19, no. 2, Mar. 1987 p 101-110 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

A computing program is used for two-dimensional non-steady fluid elastic-plastic material to calculate low-velocity jet flow penetration of steel target plates. Dynamic processes are derived concerning the target plate pitting and steady penetration stages. Qualitative results are derived for jet energy dissipation and the range of critical penetration velocities indicative of target plate resistance to penetration. Author

N88-23038# Joint Publications Research Service, Arlington, Va.
EFFICIENT NARROW LINEWIDTH WAVEGUIDE DYE LASER PUMPED BY CuCl LASER **c36**
Jinrong Tang, Chunyang Jing, Guiyan Zhang, and Fucheng Lin *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 21-26 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Jul. 1987 p 399-402 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

An efficient narrow linewidth wave-guide dye laser pumped by a CuCl laser is reported. With this tunable dye laser, a conversion efficiency of 12.5 percent, linewidth of 4 GHz, wide band ASE background of 4.7 percent, and a divergence angle of 3 mrad were obtained. The paper also provides a comparison of the output characteristics for some dye laser resonators. Author

N88-23039# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL RESEARCH ON SKIN REFLECTION, TRANSMISSION, ABSORPTION OF LIGHT RAYS **c52**
Jianmin Tang and Changyu Fu *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 32-39 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Jul. 1987 p 435; 440-443 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

A 50 W tungsten halogen lamp was used in an experimental apparatus designed to measure the absorbability, reflectivity, and transmissivity of human skin with respect to light. Tests were made on free skin, living fingers, and skin plus subcutaneous tissue. It was found that when light impinges on the human body, reflection occurs not only at the skin surface but also in the layers inside the skin and in the subcutaneous tissue. As light penetrates, if it collides with blood, then the reflectivity and transmissivity curves exhibit absorption peaks identical to blood. When skin or human bodies are illuminated, the variation tendencies in reflectivity and transmissivity are respectively the same. These results point to the conclusion that future research should deal with whole structures rather than single tissue layers. For whole-body illumination, the following propositions are supported: (1) between 400 and 800 nm, the variational tendencies of the maximum reflectivity curve are fundamentally the same; (2) in that range, the maximum reflectivity curve has the same absorption peaks as for blood; and (3) reflectivity is lowest and absorption highest with respect to violet light. Author

N88-23040# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF ULTRASHORT TRAVELING-WAVE AMPLIFIED SPONTANEOUS EMISSION Abstract Only **c36**
Wenchong Li, Changlong Ning, Zuozhu Huang, Jian Chen, and Wanlun Wang *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 41 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 7, 20 Jun. 1987 p 393-398 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

Ultrashort traveling-wave amplified spontaneous emission (ASE) light pulses (50 picoseconds) were generated by nitrogen laser pumping, and 8 to 15 ps light pulses were generated by frequency doubled and mode-locked Nd:YAG laser pumping. The pulse shape and spectrum of traveling-wave and non-traveling-wave ASE were measured with a streak camera and an optical multichannel analyzer. Computer simulation of the temporal behavior of the traveling-wave ASE is presented, and the calculation is in good agreement with the experimental results. Author

N88-23041# Joint Publications Research Service, Arlington, Va.
OBSERVATION OF SYNCHRONOUSLY TRANSIENT PUMPED MODE-LOCKING DYE LASER UNDER NEGATIVE CAVITY DETUNING Abstract Only **c36**
Ningyi Luo and Hongxing Wu et al. *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 42 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 10, 20 Oct. 1987 p 583-585 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

The second-harmonic pulse train from an actively/passively mode-locked Nd:YAG laser is used as the pumping source, and the negative cavity detuning effect of synchronously transient pumped mode-locking of a rhodamine 6G dye laser with only 12 modulations is studied. It is found that under negative cavity detuning the laser pulse is a two-spike structure. The sub-spike disappears and the single pulse appears with the matched cavity length. Author

N88-23042# Joint Publications Research Service, Arlington, Va.
DISCUSSION OF TWO-MODE TWO-PHOTON CW LASER OSCILLATION Abstract Only **c36**
Songgeng Sun *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 43 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 10, 20 Oct. 1987 p 589-593 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

The nondegenerate two-photon CW laser oscillation process using the stationary state solution of the reduced optical Bloch equation is discussed. The formulas for gain, saturation, dispersion and frequency pulling of the laser material are obtained. The results are compared with those of the mono-mode two-photon lasers. The effects of coupling between the two modes on the characteristics are analyzed. Author

N88-23600# Bundesanstalt fuer Arbeitsschutz und Unfallforschung, Dortmund (West Germany).
SPECTRORADIOMETRY IN INDUSTRIAL SAFETY [SPEKTRALRADIOMETRIE IM ARBEITSSCHUTZ]
Guenter Ott and Paul Schreiber *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 239-248 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-23043# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
EFFICIENCY OF SOME COMPUTATIONAL TECHNIQUES FOR ELECTROMAGNETIC SCATTERING PROBLEMS
A. P. M. Zwamborn Jun. 1987 88 p
(PB88-148895; Rept-1987-16) Avail: NTIS HC A05/MF A01 CSCL 20N

The performance of a number of iterative schemes for electromagnetic scattering problems was investigated. The scattering problem is formulated as a field representation in which the scattered field is excited by contrast sources of the contrasting object. The problem was reduced to one that consists of constitutive relations between the field quantities and the constrast sources and a spectral relation between their spatial Fourier transforms. The root-mean-square error of the contrast source approximation were defined. Some iterative schemes were subsequently developed in such a way that in each iteration the error decreases. For the one dimensional problem of a plane wave scattered by a dielectric slab, numerical results show the rate of convergence of the various schemes. Author

N88-23044# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
COORDINATE-MOMENTUM PROBABILITY OPERATOR FOR POINT PARTICLES IN A STATIONARY ELECTROMAGNETIC FIELD
V. V. Kuryshkin and E. E. Entralgo 1987 15 p In RUSSIAN; ENGLISH summary
(DE88-701165; JINR-R-4-87-221) Avail: NTIS (US Sales Only) HC A03/MF A01

The quantum-mechanical description with a joint coordinate-momentum probability density for any quantum state in the case of a system of potentially interacting point particles placed in an external stationary electromagnetic field is under consideration. A construction of the coordinate-momentum probability operator which determines all the other quantum operators and provides a quantization invariant under gauge transformations of the electromagnetic potential was performed. DOE

N88-23045# Naval Ocean Systems Center, San Diego, Calif.
IREPS (INTEGRATED REFRACTIVE EFFECTS PREDICTION SYSTEM) 3.0, USER'S MANUAL Final Report
W. L. Patterson, C. P. Hattan, H. V. Hitney, R. A. Paulus, and K. D. Anderson Sep. 1987 101 p
(AD-A190398; NOSC/TD-1151) Avail: NTIS HC A06/MF A01 CSCL 20N

The purpose of this manual is to introduce the reader to a variety of effects that the lower atmosphere (troposphere) has on the performance of many naval electromagnetic (EM) systems and to describe the use of the Integrated-Refractive-Effects Prediction System (IREPS) Revision 3.0. The effects of concern here are only significant at EM frequencies above 100 megahertz (MHz) and, therefore, capable of affecting radar, ultrahigh, frequency (uhf) and microwave communications, electronic warfare, and missile guidance systems. The effects of the ionosphere has on high frequency (hf) communications, or other systems, are specifically not included in this document. IREPS has been developed, and is continuing to be refined at NOSC, to give a shipboard environmental-data processing and display capability of comprehensive refractive-effects assessment upon naval surveillance, communications, electronic warfare, and weapons guidance systems. IREPS has been successfully used under operational conditions aboard most CV/CVNs to assess the exploit refractive effects in a tactical situation. Prior to describing the products and operation of IREPS Revision 3.0, a background discussion of refractive effects, their causes, and resulting benefits or detriments to naval EM systems is presented. GRA

N88-23046# Hypress, Inc., Elmsford, N.Y.
THE SUPERCONDUCTING PHASE SHIFTER IN THE DEVELOPMENT OF A TERAHERTZ IMAGING RADAR SYSTEM Final Technical Report, Aug. 1986 - Jan. 1987
S. Baliga, M. Radparvar, and S. M. Faris Oct. 1987 44 p
(Contract F19628-86-C-0117)
(AD-A190666; RADC-TR-87-157) Avail: NTIS HC A03/MF A01 CSCL 09A

A Terahertz Imaging Radar System which exploits superconductive electronics for all of its major components is described in this report. In particular, the importance of the superconducting millimeter (mm) wave phase shifter in the development of such systems has been fully investigated. The experimental and theoretical results presented here are better than we expected to achieve under Phase 1 of the project. Conventional technology is unable to provide that high frequencies required to obtain small apertures for target acquisition. Superconducting technology offers a high performance, very broadband and low power, mm and sub-mm wave phase shifter based on superconducting microstrips. The physics of the non-equilibrium superconductivity underlying the operation of the superconducting microstrip phase shifter has been studied. Theoretical analysis and numerous experimental results show that superconducting stripline modulation leading to phase velocity reduction and subsequent phase shift is achievable by quasi-particle injection. A digital N-bit phase shifter based on the superconducting microstrip transmission line is proposed for development. The implementations of such a mm and sub-mm wave phase shifter will fulfill a crucial need in the development of the Terahertz Imaging Radar. GRA

N88-23047# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
ANALYSIS AND EXPERIMENTS CONCERNING THE PERFORMANCE AND CALIBRATION OF COMPACT ANTENNA-TEST RANGES Ph.D. Thesis
P. A. Beeckman Sep. 1987 170 p
(PB88-169263; ISBN-90-9001727-5) Avail: NTIS HC A08/MF A01 CSCL 20N

Some aspects concerning the performance and calibration of Compact Antenna-Test Ranges (CATR) are studied. An introduction is provided on basic antenna measurements concepts and a review is given of several antenna measurement methods. Special attention is paid to the two reflector CATR system. A method is described to predict the test zone field distribution of a CATR with serrated reflector edges. In addition, the far field behavior of uniformly illuminated and serrated aperture distributions is investigated. Subsequently, an analysis is given of a nonideal measurement situation in terms of plane wave spectra. These results are applied later. A new method to evaluate the test zone field of a CATR is studied. Finally, a calibration method for antenna measurements on a CATR is proposed. Simulations and a few one dimensional measurements show the feasibility of the method. Author

N88-23048# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
ANALYSIS AND EXPERIMENTS CONCERNING THE PERFORMANCE AND CALIBRATION OF COMPACT ANTENNA-TEST RANGES Ph.D. Thesis
Petrus Alphons Beeckman 1987 171 p Sponsored by the Netherlands Technology Foundation
(ISBN-9-09-001727-5; ETN-88-92231) Avail: NTIS HC A08/MF A01

Application of serrated edges in reflector antenna systems and in compact antenna test ranges is introduced. Antenna measurement using the plane wave spectrum concept is outlined. Evaluation of compact antenna-test ranges using plane wave spectral analysis is described. Calibration of far field antenna test ranges is discussed. ESA

N88-23049# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung HF-Physik.
DETERMINATION OF CHARACTERISTIC RADIATION PROPERTIES OF A TORUS ANTENNA: INTEGRAL EQUATION METHOD
Manfred Zink Oct. 1987 96 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1106)
(DFVLR-FB-87-46; ISSN-0171-1342; ETN-88-92318) Avail: NTIS HC A05/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 30.50 DM

The integral equation method is used to investigate characteristic radiation properties of a torus antenna. The solution of the integral equation gives the surface-current distribution. Knowing the current distribution, the antenna input impedance and the radiation pattern can be computed. These characteristic parameters are determined for a dipole in free space, a monopole over a circular ground plane, and a torus antenna. Approximations are necessary to put the integral equation method into practice. Despite these assumptions, the results in the far field region are in good agreement with measured data. For the prediction of the input impedance no satisfactory results can be obtained. ESA

N88-23050# FUBA Hans Kolbe und Co., Bad Saizdetfurth (West Germany). Unternehmensbereich Nachrichtenuebertragungstechnik.

AN OUTDOOR UNIT FOR DIRECT BROADCAST SATELLITE (DBS) DIGITAL SOUND RECEPTION Final Report, Mar. 1985

Werner Mielke Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 42 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany

(BMFT-FB-W-86-016; ISSN-0170-1339; ETN-88-92328)

Copyright Avail: NTIS HC A03/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Federal Republic of Germany, 8.50 deutsche marks + MWST

A low cost outdoor unit for direct broadcast satellite digital sound reception was developed. It consists of a frequency converter which converts the input frequency 11.9 GHz to 118 MHz with low frequency drift. The antenna used is a 40 cm offset parabolic disk equipped with a feed horn and a polarizer. Radiating cavity resonators were also investigated. It is shown that these antennas are suitable for satellite reception. ESA

N88-23051# Begeleidingscommissie Remote Sensing, Delft (Netherlands).

PRELIMINARY STUDY OF A COHERENT RADAR [VOORSTUDIE COHERENTE RADAR]

G. P. deLoor, P. Hoogeboom, G. J. L. Nooren, H. Pouwels, L. Krul, and P. Snoeij (Technische Hogeschool, Delft, Netherlands) Jun. 1986 71 p In DUTCH

(BCRS-86-03; ETN-88-91550) Avail: NTIS HC A04/MF A01

A study for the construction of a Synthetic Aperture Radar (SAR) was performed. The consequences of the choice of the C-band are discussed. Formulas for the design of a coherent radar system are given. Results of position measurements during a flight representative of measuring flight with a coherent radar system are presented. The preprocessing and data storage system, the antenna system and the emitter-receiver, and the SAR-processing are discussed. Proposals for the realization of the radar system are made. ESA

N88-23052# European Space Agency, Paris (France).

RESEARCH ON FARADAY ROTATORS AND QUARTER-WAVE PLATES OF A 35-GHz RADAR SIGNATURE SYSTEM

Reinhard Hammel (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) Dec. 1987 90 p Transl. into ENGLISH of Untersuchungen an Faradayrrotatoren und Zirkularisa-Toren eines 35-GHz-Radar-Signatur-Systems (Oberpherpfaffenhofen, Fed. Republic of Germany, DFVLR), Mar. 1987 77 p Original language document was announced as N88-10236

(ESA-TT-1081; DFVLR-FB-87-14; ETN-88-91976) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 26 DM

It is shown which polarization ellipses can be generated by a quarter-wave plate by taking into account the effects of phase deviations of the quarter-wave plates from pi/4. The mode of operation of quarter-wave plates and Faraday rotators in transmitting and receiving antennas is presented, especially as to setting errors. It is shown how the slope of the major axis of a polarization ellipse can be measured by the use of two independent orthogonally polarized receiving antennas if the polarizations of the receiving antennas are determined by quarter-wave plates and Faraday rotators. The misadjustment of the Faraday rotators caused by hysteresis effects is demonstrated with respect to linear polarization; it is shown how to avoid these errors. ESA

N88-23053# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communications.

[ACTIVITIES REPORT OF THE DEPARTMENT OF SYSTEMS AND COMMUNICATIONS] Annual Report, 1986 [RAPPORT SCIENTIFIQUE 1986 DU DEPARTEMENT SYSTEMES ET COMMUNICATIONS]

Sep. 1987 109 p In FRENCH

(ENST-87D004; ISSN-0751-1345; ETN-88-92174) Avail: NTIS HC A06/MF A01

The research activities include work on stochastic systems, binary data treatment, modeling techniques, numerical communication theory, pattern recognition, speech recognition, and architectures for signal treatment. ESA

N88-23054# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Electronique et Signal.

ALGORITHMS AND ARCHITECTURES FOR ACOUSTIC PHONETICAL DETECTION OF CONTINUOUS SPEECH Ph.D. Thesis [ALGORITHMES ET ARCHITECTURES POUR LE DECODAGE ACOUSTICO-PHONETIQUE DE LA PAROLE CONTINUE]

Dominique Vicard Oct. 1987 216 p In FRENCH

(ENST-87E016; ISSN-0751-1353; ETN-88-92178) Avail: NTIS HC A10/MF A01

The algorithm analysis includes choice of parameters, vector quantification, dynamic programming, and transient detection. The integrated circuit architecture analysis includes the solutions to the implementation of vector quantification, dynamic programming, and selection. The CMOS implementation of the integrated circuit is described. The cost/performance ratio of the described device is judged excellent. ESA

N88-23055*# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.

EXACT IMAGE THEORY FOR THE PROBLEM OF DIELECTRIC/MAGNETIC SLAB

I. V. Lindell May 1987 32 p

(Grant NAG5-270)

(NASA-CR-182865; NAS 1.26:182865; PB88-171855; ISBN-951-754-241-0; Rept-16) Avail: NTIS HC A03/MF A01 CSCL 20N

Exact image method, recently introduced for the exact solution of electromagnetic field problems involving homogeneous half spaces and microstrip-like geometries, is developed for the problem of homogeneous slab of dielectric and/or magnetic material in free space. Expressions for image sources, creating the exact reflected and transmitted fields, are given and their numerical evaluation is demonstrated. Nonradiating modes, guided by the slab and responsible for the loss of convergence of the image functions, are considered and extracted. The theory allows, for example, an analysis of finite ground planes in microstrip antenna structures. Author

N88-23056# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.

THEORETICAL AND NUMERICAL SOLUTION OF THE FORWARD-SCATTERING PROBLEM IN A CIRCULARLY CYLINDRICAL CONFIGURATION

M. D. Verweij Sep. 1987 81 p

(PB88-173489; Rept-1987-25) Avail: NTIS HC A05/MF A01 CSCL 20N

Electromagnetic fields have shown to be an important tool in the geophysical exploration of a borehole. Using a transmitter and one or more receivers, located inside the borehole, an electromagnetic field can be generated and detected which depends upon the formation surrounding the borehole. First the behavior of the electromagnetic field in such a circularly cylindrical configuration was investigated theoretically using two different approaches: the transfer-matrix formalism and the scattering-matrix formalism. The transfer-matrix formalism was implemented

numerically on a computer. Various numberical results were listed, both in the spectral and the spatial domain. GRA

N88-23057# Technische Hogeschool, Delft (Netherlands). Afd. der Elektrotechniek.
FINITE ELEMENTS FOR THE COMPUTATION OF THREE-DIMENSIONAL ELECTROMAGNETIC FIELDS IN INHOMOGENEOUS MEDIA (REVISED)
G. Mur and A. T. deHoop Sep. 1987 27 p
(PB88-173471; Rept-1987-24) Avail: NTIS HC A03/MF A01 CSCL 20N

A type of vectorial expansion functions for the finite-element modeling of three-dimensional propagation and induction type electromagnetic fields is capable of handling the field near interfaces of discontinuity in the electromagnetic properties of the media more accurately than previous known ones, and is therefore to be preferred when computing electromagnetic fiels in, for example, borehole configurations. To test the efficiency as compared with conventional elements, the field in a mathematical model configuration is analyzed. A performance coefficient expresses the relative efficiencies of different types of elements. For the test problem, the elements prove to be superior, especially when the media are strongly inhomogeneous. For weakly inhomogeneous media, the conventional elements are more efficient. GRA

N88-23058# Academy of Sciences of the Ukrainian SSR, Kharkov. Inst. Radiofiziki i Ehlektroniki.
BEAM WAVES IN RANDOM INHOMOGENEOUS MEDIA
F. G. Bass and G. M. Pritula 1986 44 p In RUSSIAN; ENGLISH summary
(DE88-701631; INIS-SU-4/A; Preprint-N-320) Avail: NTIS (US Sales Only) HC A03/MF A01

Propagation and nonstabilities of waves excited by a beam of charged particles are considered in media with fluctuations of dielectric permitivity at different suggestions concerning their statistic properties. DOE

N88-23059*# Ohio State Univ., Columbus. ElectroScience Lab.
A VERY WIDE FREQUENCY BAND PULSED/IF RADAR SYSTEM
D. N. Jones and W. D. Burnside Mar. 1988 156 p
(Grant NsG-1613)
(NASA-CR-182889; NAS 1.26:182889; OSU-TR-716148-28)
Avail: NTIS HC A08/MF A01 CSCL 17I

A pulsed/IF radar for compact range radar cross section measurements has been developed which converts RF returns to a fixed IF, so that amplification and grating may be performed at one frequency. This permits the use of components which have optimal performance at this frequency which results in a corresponding improvement in performance. Sensitivity and dynamic range are calculated for this system and compared with our old radar, and the effect of pulse width on clutter level is also studied. Sensitivity and accuracy tests are included to verify the performance of the radar. Author

N88-23060# North Carolina Agricultural and Technical State Univ., Greensboro.
DISCRETE GENERALIZED NETWORKS: APPLICATION TO INTEGER CONSTRAINED FLOW PROBLEMS Final Report, 15 Apr. 1985 - 14 Oct. 1987
Sanjiv Sarin 15 Oct. 1987 29 p
(Grant DAAG29-85-G-0086)
(AD-A190823; ARO-22653.6-MA-H) Avail: NTIS HC A03/MF A01 CSCL 13H

A generalized network structure is essentially a linear program whose coefficient matrix ignoring simple bounds on variables, contains at most two non-zero entries in each column. When flow variables are required to be integers, the resulting problem is termed Discrete Generalized Network (DGN). The DGN structure has been used to model problems such as scheduling variable length networks, designing communication networks and capital allocation problems. The primary objective of this project has been to identify solution methodologies for problems having the DGN structure. Some secondary outcomes of the research include a program for generating random networks and an application of DGN formulation to model an important problem in flexible manufacturing systems. GRA

N88-23061# Ohio State Univ., Columbus. ElectroScience Lab.
K-PULSE ESTIMATION FROM INCOMPLETE MULTIPLE-FREQUENCY SCATTERING DATA AND TARGET IDENTIFICATION
Gonul Turhan and David L. Moffatt Sep. 1987 17 p
(Contract N00014-86-K-0202)
(AD-A190827; ESL-718048-5) Avail: NTIS HC A03/MF A01 CSCL 17I

The K-pulse waveforms of realistic aircraft models are obtained from incomplete multiple-frequency scattering data without a priori knowledge of the target complex natural resonances (CNR). The approach is based on minimization of the late-time energy content of the K-pulse response at several aspects and/or polarizations. Use of the K-pulse as an identification tool is demonstrated. GRA

N88-23062# Naval Postgraduate School, Monterey, Calif.
A COMPUTER MODEL INVESTIGATION OF A HALF SQUARE LOG-PERIODIC ARRAY M.S. Thesis
Mustafa Erdeviren Dec. 1987 168 p
(AD-A190955; NPS62-88-008) Avail: NTIS HC A08/MF A01 CSCL 09A

This thesis investigates the potential of a half square log-periodic array for use by the military over the frequency range of 2 to 30 MHz using a computer simulation technique by numerical methods. Using the Numerical Electromagnetics Code (NEC), a selected model was run in free space and over perfect ground to obtain data for radiation patterns and element currents on the array. After the evaluation of the NEC data, the results of the investigation show that half square log-periodic array with dual feed and switched transmission line has characteristics of a successful log-periodic structure with a unidirectional radiation pattern, over the design frequency range of 2 to 30 MHz, showing promise for military applications. GRA

N88-23063# Imperial Coll. of Science and Technology, London (England).
ENHANCED BACKSCATTERING FROM ROUGH SURFACES Periodic Report No. 2, Sep. - Dec. 1987
J. C. Dainty 18 Jan. 1988 9 p
(Contract DAJA45-87-C-0039)
(AD-A190995) Avail: NTIS HC A02/MF A01 CSCL 17I

A bibliography is begun on surface and volume enhanced backscattering. Minor upgrades to the scatterometer have been made and the options for extending the wavelength coverage to the 1 to 4 micrometers range are being evaluated in detail. Some two-dimensional surfaces (random gratings) have been made and are currently being measured. Some preliminary measurements of the Stokes' parameters as a function of scattering angle have been made for surface 83 at normal incidence and lambda = 633 nm (used by O'Donnell and Mendez. During calibration of the scatterometer a measurement was made of a freshly prepared Magnesium Oxide surface, which is frequently claimed to be a good approximation to a Lambertian scatterer. The results exhibit the enhanced backscatter peak. The energy in this peak is small and the scattering is quite Lambertian for incident angles less than 30 deg. GRA

N88-23064# Royal Signals and Radar Establishment, Malvern (England).
MULTIPLE ADDRESS FACILITY FOR PACKET RADIO: AN INVESTIGATION OF PERFORMANCE/COMPLEXITY TRADE OFF
C. J. Gove Nov. 1987 21 p
(AD-A191043; RSRE-MR-4096; DRIC-BR-105198) Avail: NTIS HC A03/MF A01 CSCL 25E

The implementation of a multicast protocol on the packet

radio network simulator was initiated in an attempt to investigate the performance/complexity/efficiency trade off of multiple address protocols in narrowband packet radio networks. A multicast data packet has an address list of up to 8 destinations together with a list of selected relay units. The list of destinations with an amended list of relay units will be included in the data packet transmitted by each identified relay unit. All the results produced are a product of the RSRE Packet Radio Network computer simulation that was adapted from a single destination packet, with node by node acknowledgement only, to a multiple destination packet with destination to source acknowledgement. The packets are transmitted with the aim of a fast, reliable, efficient delivery together with a slow but efficient acknowledgement of that delivery. The results obtained, displayed an overall improvement in data throughput with a general reduction in the number of transmissions required to obtain the increased packet delivery. With the limited information throughput existing with the narrow band packet radio protocol any improvement in throughput is considered significant. GRA

N88-23065# Mission Research Corp., Alexandria, Va.
PULSED POWER SIMULATION PROBLEMS IN MAGIC Technical Report, 19 Apr. 1984 - 18 Apr. 1987
Bruce Coplen and Richard Worl 18 Apr. 1987 164 p
(Contract DNA001-84-C-0208; DNA Proj. T99-QMXL)
(AD-A191110; MRC/WDC-R-124; DNA-TR-87-148) Avail: NTIS HC A08/MF A01 CSCL 20N

This report documents canonical pulsed power simulation problems designed to be performed with the two-and-one-half dimensional, particle-in-cell code, MAGIC. The problems were created to furnish new users of MAGIC with experience in the application of simulation techniques to realistic pulsed power problems. The problems range from simple electromagnetic propagation to self-consistent diode operation. Each problem is presented in three parts: (1) a problem description, complete and self-contained, (2) a suggested approach, including actual input data, and (3) an analytical solution, allowing comparison with simulation results. GRA

N88-23066# Naval Ocean Systems Center, San Diego, Calif.
WAVFLD: A PROGRAM TO COMPUTE IONOSPHERIC HEIGHT GAIN FUNCTIONS AND FIELD STRENGTHS AT VLF Interim Report, Oct. 1986 - Sep. 1987
J. A. Ferguson and L. R. Hitney Nov. 1987 74 p
(AD-A191159; NOSC/TD-1192) Avail: NTIS HC A04/MF A01 CSCL 20N

Implementation of a full-wave fields program developed for calculations at ELF is described. The program incorporates modifications to the original code for use at VLF, including allowance for multiple modes. Other changes relate to improving compatibility of the basic program setup with that of other programs in the Defense Nuclear Agency repertoire. GRA

N88-23067# Michigan Univ., Ann Arbor. Communications and Signal Processing Lab.
ON THE CAPACITY OF CHANNELS WITH UNKNOWN INTERFERENCE
M. V. Hegde, W. E. Stark, and D. Teneketzis 14 Aug. 1987 48 p
(Contract N00014-85-K-0545; Grant NSF ECS-85-17708)
(AD-A191160) Avail: NTIS HC A03/MF A01 CSCL 12I

The process of communicating in the presence of interference, which is unknown or hostile, is modelled as a two-person zero sum game with the communicator and jammer as players. The objective function considered is mutual information. The communicator's strategies are distributions on the input alphabet and on a set of quantizers. The jammer's strategies are distributions on the noise power subject to certain constraints. Various conditions are considered on the jammer's strategy set and on the communicator's knowledge. For the case with the decoder uninformed of the actual quantizer chosen it is shown that, from the communicator's perspective, the worst-case jamming strategy is a distribution concentrated at a finite number of points thereby converting a functional optimization problem into a non-linear programming problem. Moreover, we are able to characterize the worst-case distributions by means of necessary and sufficient conditions which are easy to verify. For the case with the decoder informed of the actual quantizer chosen we are able to demonstrate the existence of saddle-point strategies. The analysis is also seen to be valid for a number of situations where the jammer is adaptive. GRA

N88-23068# Naval Postgraduate School, Monterey, Calif.
MULTICHANNEL 2-D POWER SPECTRAL ESTIMATION AND APPLICATIONS Ph.D. Thesis
Hamdy T. El-Shaer Dec. 1987 304 p Original contains color illustrations
(AD-A191273) Avail: NTIS HC A14/MF A01 CSCL 12C

Spectral estimation for multiple 2-D signals by model-based methods is developed. The procedures compute the entire spectral matrix of autospectra and cross spectra for the set of 2-D signals. Spectral analysis by autoregressive (AR) modeling is studied extensively. Specific differences between AR models for this problem and those for lower dimensional problems are highlighted. An extension of the Jackson-Chien method for combining estimates with single quadrant support is proposed and a method is developed for estimating the model parameters directly from the data (i.e., without prior estimation of a correlation matrix). A measure of the similarity of two spectral estimates based on the statistical divergence is proposed and used to compare various spectral estimates. GRA

N88-23069# Columbia Univ., New York, N.Y. Dept. of Electrical Engineering.
PROBLEMS IN INTEGRATED NETWORKS Final Report, 1 Apr. 1985 - 31 Dec. 1987
Mischa Schwartz, Thomas E. Stern, and Aurel A. Lazar 15 Feb. 1988 10 p
(Contract N00014-85-K-0371)
(AD-A191391) Avail: NTIS HC A02/MF A01 CSCL 25D

This final report covers work carried out under ONR Contract N00014-85-K-0371. The basic problems addressed concerned transmitting mixtures of traffic of disparate types over a variety of communication networks. The research fell into three categories: (1) hybrid multiplexing, (2) packet voice, and (3) optimal flow control. GRA

N88-23070*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE COMMUNICATION LINK PROPAGATION DATA FOR SELECTED CITIES WITHIN THE MULTIPLE BEAM AND STEERABLE ANTENNA COVERAGE AREAS OF THE ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE
Robert M. Manning Apr. 1988 214 p
(NASA-TM-100861; E-4073; NAS 1.15:100861) Avail: NTIS HC A10/MF A01 CSCL 17B

Rain attenuation propagation data for 68 cities within the coverage area of the multiple beam and steerable antennas of the Advanced Communications Technology Satellite (ACTS) are presented. These data provide the necessary data base for purposes of communication link power budgeting and rain attenuation mitigation controller design. These propagation parameters are derived by applying the ACTS Rain Attenuation Prediction Model to these 68 locations. The propagation parameters enumerated in tabular form for each location are as follows: (1) physical description of the link and location (e.g., latitude, longitude, antenna elevation angle, etc.), link availability versus attenuation margin (also in graphical form), fading time across fade depths of 3, 5, 8, and 15 dB versus fade duration, and required fade control response time for controller availabilities of 99.999, 99.99, 99.9, and 99 percent versus sub-threshold attenuation levels. The data for these specific locations can be taken to be representative of regions near these locations. Author

N88-23071*# Ohio State Univ., Columbus. ElectroScience Lab.
A DIAGNOSTIC TECHNIQUE USED TO OBTAIN CROSS RANGE RADIATION CENTERS FROM ANTENNA PATTERNS
T. H. Lee and W. D. Burnside May 1988 34 p
(Grant NsG-1613)
(NASA-CR-182903; NAS 1.26:182903; ESL-76158-30) Avail: NTIS HC A03/MF A01 CSCL 17B

A diagnostic technique to obtain cross range radiation centers based on antenna radiation patterns is presented. This method is similar to the synthetic aperture processing of scattered fields in the radar application. Coherent processing of the radiated fields is used to determine the various radiation centers associated with the far-zone pattern of an antenna for a given radiation direction. This technique can be used to identify an unexpected radiation center that creates an undesired effect in a pattern; on the other hand, it can improve a numerical simulation of the pattern by identifying other significant mechanisms. Cross range results for two 8' reflector antennas are presented to illustrate as well as validate that technique. Author

N88-23072# Nauchno-Issledovatelskij Inst. Ehlekt- Rofizicheskoj Apparatury, Leningrad (USSR).
KOMPOT PROGRAM COMPLEX FOR THE CALCULATION OF SPATIAL MAGNETOSTATIC FIELDS OF ELECTROMAGNETIC SYSTEMS
N. I. Dojnikov, E. A. Lamzin, A. S. Simakov, and S. E. Sychevskij 1986 13 p In RUSSIAN
(DE88-701691; NIIEFA-P-B-0741) Avail: NTIS (US Sales Only) HC A03/MF A01

A complex program for calculating the spatial magnetic fields of an electrophysical plant's electromagnetic systems is described. The program is accomplished in FORTRAN. The method is based on the application of a modified scalar potential with an additional vector, determined in the local subarea of the calculation area. Digitization of differential equations is performed using the finite element method. DOE

N88-23073*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CASE STUDY OF ACTIVE ARRAY FEED COMPENSATION WITH SIDELOBE CONTROL FOR REFLECTOR SURFACE DISTORTION
R. J. Acosta, A. J. M. Zaman, E. A. Bobinsky, A. R. Cherrette, and S. W. Lee (Illinois Univ., Urbana-Champaign.) 1988 7 p Presented at the 1988 AP-S/URSI International Symposium, Syracuse, N.Y., 6-10 Jun. 1988; sponsored by IEEE
(NASA-TM-100287; E-3932; NAS 1.15:100287) Avail: NTIS HC A02/MF A01 CSCL 20N

The feasibility of electromagnetically compensating for reflector surface distortions has been investigated. The performance characteristics (gain, sidelobe levels, etc.) of large communication antenna systems degrade as the reflector surface distorts mainly due to thermal effects from a varying solar flux. The techniques described in this report can be used to maintain the design performance characteristics independently of thermal effects on the reflector surface. With the advent of monolithic microwave integrated circuits (MMIC), a greater flexibility in array-fed reflector system design can be achieved. MMIC arrays provide independent control of amplitude and phase for each of many radiating elements of the feed array. It is assumed that the surface characteristics (x,y,z, its first and second derivatives) under distorted conditions are known. Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N88-23074# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
TIMING FOR SUBNANOSECOND PULSES
K. Heidel and H.-G. Ortlepp 1987 8 p In RUSSIAN; ENGLISH summary
(DE88-701390; JINR-R-13-87-184) Avail: NTIS (US Sales Only) HC A02/MF A01

Timing mark shapers for signals with subnanosecond front and fall times on the basis of fast comparator microcircuits were developed and tested. Effects of a signal shaping method, of a choice of used comparators and assembling circuit types on dependence of timing mark shift on the time walk were investigated. It is shown that a minimum time shift can be obtained during timing mark shaping on the fall of attenuated signal. DOE

N88-23075# Oak Ridge National Lab., Tenn.
A PC-BASED RECEIVER-DECODER FOR REMOTE SENSOR MONITORING
C. L. Britton, Jr. and E. Madden 1987 4 p Presented at the Southeastcon '88 Conference and Exhibit, Knoxville, Tenn., 11 Apr. 1988
(Contract DE-AC05-84OR-21400)
(DE88-004733; CONF-880433-2) Avail: NTIS HC A02

A PC-based serial data receiver-decoder is described that decodes bi-phase-mark encoded data. Its design philosophy, data format, and hardware implementation are described. Two serial interface board designs as well as the advantages and disadvantages of both are discussed. The important software features implemented for control of this system are described. Some application information is also discussed relative to intrusion detection and environmental monitoring. DOE

N88-23076# AEG-Telefunken, Ulm (West Germany). Fachgebiet Uebertragungstechnik.
CONSTRUCTION OF A 60 GHz TRAVELING WAVE TUBE (TWT) FOR INTERSATELLITE LINK ON GEOSTATIONARY ORBIT (ISL/TWT) Final Report, Mar. 1985
Gerold Lippert and Peter Malzahn Bonn, Fed. Republic of Germany Bundesministerium fuer Forschung und Technologie Dec. 1986 61 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie, Bonn, Fed. Republic of Germany
(BMFT-FB-W-86-015; ISSN-0170-1339; ETN-88-92327)
Copyright Avail: NTIS HC A04/MF A01; Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 12.50 DM + MWST

For communication between geostationary satellites, a transmitter using a TWT amplifier with frequency 60 GHz and output power of a few watts is proposed. A focusing electrode which suppresses the edge emission and a mixed metal cathode with a low beam compression ratio are employed in the gun. For the beam tester a transmission factor of greater than 99 percent is achieved using an extremly precise machined integrated PPM system and SM2CO17 magnets. An easily manufacturable delay line structure was realized using a diffusion brazed double comb line consisting of only a small number of parts. The delay line has the characteristics of a coupled resonator line and operates in the slot mode. The one stage collector can operate with a strongly reduced potential. The TWT has beam voltage 15 kV; beam current 50 ma; operating band 59 to 63.5 GHz; saturated output power greater than 10 watts plus gain at saturation over 28 dB; and 1 dB instantaneous bandwith 1.35 GHz. ESA

N88-23077# Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands).
OPTICAL SENSORS FOR THE MEASUREMENT OF ELECTRIC CURRENT AND VOLTAGE
W. R. Rutgers, H. J. M. Hulshof, I. J. Laurensse, and A. H. vanderWey 1987 17 p Submitted for publication
(PB88-172945; ISBN-90-353-0058-0) Avail: NTIS HC A03/MF A01 CSCL 09A

Optical sensors for the measurement of electrical current and voltage were developed for application in electric power systems. The current sensor, based on the Faraday effect in a monomode glass fiber, and the voltage sensor, based on the transverse Pockels effect in a crystal, are demonstrated in wide-band (10 MHz) interference-free measurements of pulsed currents and impulse voltage. Author

N88-23078# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.
TACTICAL RUBIDIUM FREQUENCY STANDARD (TRFS) Final Technical Report, Oct. 1983 - Jul. 1986
T. Kwon, T. Hahn, R. Dagle, J. Horst, and T. McClelland Sep. 1987 97 p
(Contract F19628-83-C-0174)
(AD-A191049; Rept-18304; RADC-TR-87-140) Avail: NTIS HC A05/MF A01 CSCL 14B

The primary objective of this contract was to design, develop, fabricate, test and evaluate pre-production models (PPM) of a Tactical Rubidium Frequency Standard (TRFS) that will meet the tactical temperature - vibration environment specifications. Innovative design has resulted in TRFS that meets the environmental requirements as well as small size, rapid warm-up, and low power consumption. To meet the vibration specification under wide temperature variations, an SC-cut voltage-controlled crystal oscillator (VCXO) having a minimum acceleration sensitivity of 4 x 10th minus 10th power/g was mounted on an internal wire-suspended vibration isolator. The VCXO output frequency of 10 MHz is tightly controlled by a servo loop with a 100 Hz bandwidth. The rubidium resonnance signal is detected by a phase-sensitive technique using sinusoidal modulation. Five multilayer PC boards are used along with discrete components. The TRFS will mount directly onto a platform without external vibration isolators. GRA

N88-23079# Stanford Univ., Calif. Center for Reliable Computing.
DESIGN OF THE DETECTOR 2: A CMOS GATE ARRAY FOR THE STUDY OF CONCURRENT ERROR DETECTION TECHNIQUES
Hendrik A. Goosen, Mario L. Cortes, and Edward J. McCluskey Jul. 1987 41 p
(Contract N00014-85-K-0600)
(AD-A191247; SU-CRC-TR-87-17; SU-CSL-TN-87-335) Avail: NTIS HC A03/MF A01 CSCL 09A

For some applications of computer systems, errors have to be detected concurrently with normal operation. This is typically done by concurrent error detection (CED) circuits. Since about 90 percent of errors in computer systems are caused by temporary failures, CED schemes have to effectively detect errors caused by temporary failures. Most CED schemes are designed with the assumption that errors are caused by events that can be modelled as single-stuck faults. There is a growing body of evidence which suggests that the single stuck-fault model does not model temporary failures very well. This report describes the Detector 2, a circuit which was designed to study concurrent error detection schemes experimentally. The purpose of the study is to find out how well the different schemes perform in the presence of real temporary failures, and to gain more knowledge of temporary failures in the process. This will also lead to better models for temporary failures. The circuit was implemented as a CMOS gate array fabricated by Fairchild Gate Array, Milpitas, California. The circuit consists of approximately 2400 equivalent gates and is packaged in a 121 pin ceramic pin-grid array package. GRA

N88-23080# Stanford Univ., Calif. Physics Lab.
INSTRUMENTATION FOR ULTRAFAST ELECTRONICS Final Report, 1 Oct. 1986 - 30 Sep. 1987
D. M. Bloom 30 Nov. 1987 122 p
(Grant AF-AFSOR-0032-87)
(AD-A191379; AFOSR-88-0008TR) Avail: NTIS HC A06/MF A01 CSCL 09A

Increasing numbers of III-V compound semiconductor devices and circuits operate in a regime where internal node testing with traditional electronic means proves impossible due to circuit loading and limited time resolution. Electrooptic sampling employs picosecond infrared laser pulses to non-invasively examine internal node voltages with 100 GHz bandwidth. Under this grant, a very low phase noise synthesizer was purchased to provide stable drive to the laser mode-locker, and a microwave synthesizer was purchased to drive the device under test up to 40 GHz. In addition, a computer aided design graphics workstation was purchased to permit the design of novel ultrafast devices. In-house design, fabrication, and detailed diagnostic testing of ultrafast III-V integrated circuits are now all possible at this unique facility. GRA

N88-23081# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
EFFECTS OF CADMIUM ELECTRODE PROPERTIES ON NICKEL-CADMIUM CELL PERFORMANCE
A. H. Zimmerman 30 Dec. 1987 24 p
(Contract F04701-85-C-0086)
(AD-A191394; TR-0086(6945-01)-2; SD-TR-88-21) Avail: NTIS HC A03/MF A01 CSCL 10C

Tests have been conducted on several nickel-cadmium cells that have exhibited a variety of performance problems, ranging from high voltages and pressures during overcharge to low capacity. The performance problems that have been specifically linked to the cadmium electrode are primarily related to two areas, poor sinter and the buildup of excessive pressure during overcharge. A number of specific nickel-cadmium cell and cadmium electrode characteristics have been studied in this work to determine what the effects of poor sinter overcharge in cells that otherwise appear normal. Several of the tests appear suitable for screening and electrodes for such problems. GRA

N88-23082# Colorado Univ., Boulder. Electromagnetics Lab.
[INVESTIGATION OF RADIATING AND GUIDING STRUCTURES IN MICROSTRIP PATCH ANTENNAS] Final Report, 16 May 1984 - 15 May 1986
David C. Chang and Edward F. Kuester 1 Feb. 1988 9 p
(Contract N00014-84-K-0349)
(AD-A191445) Avail: NTIS HC A02/MF A01 CSCL 09A

A summary of the work performed under ONR Contract N00014-84-K-0349 is presented. Results include advances in theory and design of microstrip patch antennas, development of a bivariational method to analyze antennas and open transmission lines, analysis of microstrip structures as waveguides and resonators, and a study of the effects of cover layers on microstrip antennas. GRA

N88-23083*# Old Dominion Univ., Norfolk, Va. Research Foundation.
STRATEGIES FOR CONCURRENT PROCESSING OF COMPLEX ALGORITHMS IN DATA DRIVEN ARCHITECTURES
John W. Stoughton and Roland R. Mielke Feb. 1988 73 p
(Grant NAG1-683)
(NASA-CR-181657; NAS 1.26:181657) Avail: NTIS HC A04/MF A01 CSCL 09C

Research directed at developing a graph theoretical model for describing data and control flow associated with the execution of large grained algorithms in a special distributed computer environment is presented. This model is identified by the acronym ATAMM which represents Algorithms To Architecture Mapping Model. The purpose of such a model is to provide a basis for establishing rules for relating an algorithm to its execution in a multiprocessor environment. Specifications derived from the model

lead directly to the description of a data flow architecture which is a consequence of the inherent behavior of the data and control flow described by the model. The purpose of the ATAMM based architecture is to provide an analytical basis for performance evaluation. The ATAMM model and architecture specifications are demonstrated on a prototype system for concept validation.
Author

N88-23084*# Honeywell, Inc., Bloomington, Minn. Sensors and Signal Processing Lab.
A 30 GHz MONOLITHIC RECEIVE MODULE TECHNOLOGY ASSESSMENT
J. Geddes, V. Sokolov, P. Bauhahn, and T. Contolatis Apr. 1988 31 p
(Contract NAS3-23356)
(NASA-CR-180825; NAS 1.26:180825) Avail: NTIS HC A03/MF A01 CSCL 09C

This report is a technology assessment relevant to the 30 GHz Monolithic Receive Module development. It is based on results obtained on the present NASA Contract (NAS3-23356) as well as on information gathered from literature and other industry sources. To date the on-going Honeywell program has concentrated on demonstrating the so-called interconnected receive module which consists of four monolithic chips - the low noise front-end amplifier (LNA), the five bit phase shifter (PS), the gain control amplifier (GC), and the RF to IF downconverter (RF/IF). Results on all four individual chips have been obtained and interconnection of the first three functions has been accomplished. Future work on this contract is aimed at a higher level of integration, i.e., integration of the first three functions (LNA + PS + GC) on a single GaAs chip. The report presents the status of this technology and projections of its future directions. Author

N88-23085*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TEST RESULTS OF HIGH-VOLTAGE, HIGH-POWER, SOLID-STATE REMOTE POWER CONTROLLERS
Yvette Binford Johnson and Robert E. Kapustka Mar. 1988 25 p
(NASA-TM-100322; NAS 1.15:100322) Avail: NTIS HC A03/MF A01 CSCL 09C

This report discusses the results of testing high-voltage, high-power, solid-state remote power controllers (RPC) using RPCs designed and built by John C. Sturman at the Lewis Research Center, Cleveland, Ohio, and utilizing the Autonomously Managed Power Systems (AMPS) breadboard/test facility. These test results are used to determine usefulness of the RPCs for future applications in high-voltage direct-current space power. Author

N88-23024# Joint Publications Research Service, Arlington, Va.
PRESENT, FUTURE OF AUTOMOTIVE HYBRID IC APPLICATIONS DISCUSSED
Nobuyoshi Matsuda and Atuhisa Fukuoka *In its* JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 47-59 Transl. into ENGLISH from Jidoshi Gijutsu (Tokyo, Japan), Feb. 1987 p 195-201 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-23086*# Stanford Univ., Calif. Center for Turbulence Research.
STUDYING TURBULENCE USING NUMERICAL SIMULATION DATABASES. PROCEEDINGS OF THE 1987 SUMMER PROGRAM Annual Report No. 1
Parviz Moin, ed., William C. Reynolds, ed., and John Kim, ed. Dec. 1987 322 p Program held in Stanford, Calif., 13 Jul - 7 Aug. 1987
(Contract NCC2-460)
(NASA-CR-182692; NAS 1.26:182692; SU-CTR-S87) Avail: NTIS HC A14/MF A01 CSCL 20D

The focus was on the use of databases obtained from direct numerical simulations of turbulent flows, for study of turbulence physics and modeling. Topics addressed included: stochastic decomposition/chaos/bifurcation; two-point closure (or k-space) modeling; scalar transport/reacting flows; Reynolds stress modeling; and structure of turbulent boundary layers. For individual titles, see N88-23087 through N88-23121.

N88-23087*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STOCHASTIC ESTIMATION OF CONDITIONAL EDDIES IN TURBULENT CHANNEL FLOW
R. J. Adrian (Illinois Univ., Urbana.), P. Moin, and R. D. Moser *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 7-19 (For primary document see N88-23086 16-34)
(Grant NSF ATM-86-00509)
Avail: NTIS HC A14/MF A01 CSCL 20D

Several long-standing issues regarding linear estimation and coherent structures are addressed, and some questions that were addressed partially, but never with the benefit of full, three-dimensional information are answered. The objectives were to: determine how well linear estimates approximate the field obtained by true conditional averaging, using events such as those in quadrant analysis; determine the extent to which the three-dimensional linearly estimated fields correspond to coherent structures, and the degree and manner in which they differ; evaluate the type and nature of the structural information gained by employing several different types of events; and learn more about the 3-D structure of important coherent motions that occur in wall turbulence. The results indicate that linear stochastic estimation can be used effectively in the study of numerical data bases consisting of three-dimensional vector fields, both velocity and vorticity. Two-point stochastic estimation yields more structural information and more detail than single-point estimation. The structures observed occurred repeatedly within the flow, but much can not be said about their dominance or the probability of their occurrence without further systematic studies of their frequency.
B.G.

N88-23088*# Cornell Univ., Ithaca, N.Y.
A LOW DIMENSIONAL DYNAMICAL SYSTEM FOR THE WALL LAYER
N. Aubry and L. R. Keefe (Stanford Univ., Calif.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 21-23 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

Low dimensional dynamical systems which model a fully developed turbulent wall layer were derived.The model is based on the optimally fast convergent proper orthogonal decomposition, or Karhunen-Loeve expansion. This decomposition provides a set of eigenfunctions which are derived from the autocorrelation tensor at zero time lag. Via Galerkin projection, low dimensional sets of ordinary differential equations in time, for the coefficients of the expansion, were derived from the Navier-Stokes equations. The energy loss to the unresolved modes was modeled by an eddy viscosity representation, analogous to Heisenberg's spectral model. A set of eigenfunctions and eigenvalues were obtained from direct numerical simulation of a plane channel at a Reynolds number of 6600, based on the mean centerline velocity and the channel width flow and compared with previous work done by Herzog. Using the new eigenvalues and eigenfunctions, a new ten dimensional set of ordinary differential equations were derived using five non-zero cross-stream Fourier modes with a periodic length of 377 wall units. The dynamical system was integrated for a

range of the eddy viscosity prameter alpha. This work is encouraging. B.G.

N88-23089*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SELF SIMILARITY OF TWO POINT CORRELATIONS IN WALL BOUNDED TURBULENT FLOWS
J. C. R. Hunt, P. Moin (Stanford Univ., Calif.), R. D. Moser, and P. R. Spalart *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 25-36 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

The structure of turbulence at a height y from a wall is affected by the local mean shear at y, by the direct effect of the wall on the eddies, and by the action of other eddies close to or far from the wall. Some researchers believe that a single one of these mechanisms is dominant, while others believe that these effects have to be considered together. It is important to understand the relative importance of these effects in order to develop closure models, for example for the dissipation or for the Reynolds stress equation, and to understand the eddy structure of cross correlation functions and other measures. The specific objective was to examine the two point correlation, R sub vv, of the normal velocity component v near the wall in a turbulent channel flow and in a turbulent boundary layer. The preliminary results show that even in the inhomogeneous turbulent boundary layer, the two-point correlation function may have self similar forms. The results also show that the effects of shear and of blocking are equally important in the form of correlation functions for spacing normal to the wall. But for spanwise spacing, it was found that the eddy structure is quire different in these near flows. So any theory for turbulent structure must take both these effects into account. B.G.

N88-23090*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EJECTION MECHANISMS IN THE SUBLAYER OF A TURBULENT CHANNEL
J. Jimenez, P. Moin, R. D. Moser, and L. R. Keefe (Stanford Univ., Calif.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 37-47 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

A possible model for the inception of vorticity ejections in the viscous sublayer of a turbulent rectangular channel is presented. It was shown that this part of the flow is dominated by protruding strong shear layers of z-vorticity, and it was proposed as a mechanism for their maintenance and reproduction which is essentially equivalent to that responsible for the instability of 2-D Tollmien-Schlichting waves. The efforts to isolate computationally a single structure for its study have failed up to now, since it appears that single structures decay in the absence of external forcing, but a convenient computation model was identified in the form of a long and narrow periodic computational box containing at each moment only a few structures. Further work in the identification of better reduced systems is in progress. Author

N88-23091*# Ecole Centrale de Lyon (France).
EDQNM CLOSURE: A HOMOGENEOUS SIMULATION TO SUPPORT IT. A QUASI-HOMOGENEOUS SIMULATION TO DISPROVE IT
J. P. Bertoglio, K. Squires, and J. H. Ferziger (Stanford Univ., Calif.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 53-62 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

It is known that two-point closures are useful tools for understanding and predicting turbulence. Among the various closures, the Eddy Damped Quasi-Normal Markovian (EDQNM) approach is one of the simplest and, at the same time, most useful. Direct numerical simulations (DNS) can provide information that can be used to test the validity of two-point theories. It is the purpose of the present work to use DNS to validate, or improve upon, EDQNM. A case was selected for which EDQNM is known to give satisfactory results: homogeneous isotropic turbulence. Quantities were then evaluated which may be used to test the assumptions of two-point closure approximations: spectral Lagrangian time scales. The goal was to make a careful and refined study to validate the EDQNM theory. A reference case was built for which EDQNM is likely to give poor results. An attempt to generate a quasi-homogeneous turbulent field containing organized structures, was built by artifically injecting them in the initial conditions. The results of direct simulations using such initial conditions are expected to provide a challenge for EDQNM since this kind of field is simple enough to allow comparisons with two-point theories, but at the same time contains coherent structures which cannot be expected to be accurately accounted for by closures based on expansions about Gaussianity. Author

N88-23092*# Rome Univ. (Italy).
VALIDATION OF EDQNM FOR SUBGRID AND SUPERGRID MODELS
P. Orlandi *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 63-69 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

From preliminary calculations it was concluded that the two-point Eddy Damping Quasi-Normal Markovian (EDQNM) closure accurately describes the behavior of second order moments. This closure can be applied as subgrid and supergrid models for Large Eddy Simulations at higher Reynolds numbers. In the case of homogeneous anisotropic turbulence, when the nonlinear terms are introduced the calculation becomes quite onerous but is still considerably less expensive than the calculation of a DS. The major merit of two-point closure models is that they can be easily applied to flows at Reynolds numbers that are unreachable by a DS. Work is in progress to derive expressions for the nonlinear terms that give good global conservation properties. Author

N88-23093*# Stanford Univ., Calif.
ANGULAR DISTRIBUTION OF TURBULENCE IN WAVE SPACE
G. Coleman, J. H. Ferziger, and J. P. Bertoglio (Ecole Centrale de Lyon, France) *In its* Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 71-75 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

An alternative to the one-point closure model for turbulence, the large eddy simulation (LES), together with its more exact relative, direct numerical simulation (DNS) are discussed. These methods are beginning to serve as partial substitutes for turbulence experiments. The eddy damped quasi-normal Markovian (EDQNM) theory is reviewed. Angular distribution of the converted data was examined in relationship to EDQNM. B.G.

N88-23094*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
BIG WHORLS CARRY LITTLE WHORLS
J. C. R. Hunt (Cambridge Univ., England), J. C. Buell, and A. A. Wray *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 77-94 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

The aim of the research was to explore the space-time structure of homogeneous turbulence by computing and then interpreting the two-point spectra and correlations of the velocity and pressure fields. Many of these statistics are of considerable practical importance. In particular, it is of interest to compare the different time and length integral scales and microscales for Eulerian and Lagrangian qualities, and to compare the space and time spectra. B.G.

N88-23095*# Aix-Marseilles Univ. (France). Inst. de Mecanique Statistique de la Turbulence.

STUDY OF ONE-DIMENSIONAL SPECTRAL DYNAMIC EQUATIONS OF THE REYNOLDS STRESSES IN HOMOGENEOUS ANISOTROPIC TURBULENCE: APPLICATION TO SPLIT-SPECTRUM MODELING

R. Schiestel *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 95-108 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

The CTR numerical data base generated by direct simulation of homogeneous anisotropic turbulence was used to calculate all of the terms in the spectral balance equations for the turbulent Reynolds stresses. The aim in not only to test the main closure assumptions used in the split-spectrum models, but also to try to devise improved hypotheses deduced from the statistical information. Numerical simulations of turbulent flows provide a large amount of data, a thought provoking wealth of information. The main advantage of this type of comparison is that a great variety of flows can be considered, and this is necessary to test closure hypotheses. Moreover various initial conditions can be introduced in the calculation, even if they are not experimentally feasible. All the terms in the spectral equations can be calculated. The limited Reynolds numbers of the simulations and the statistical noise caused by a small sample, particularly at the large scales, causes some difficulty in the interpretation of the results, but the method of approach proved to be a powerful tool for testing and improving spectral closures. Author

N88-23096*# Tokyo Univ. (Japan).

MODELING SCALAR FLUX AND THE ENERGY AND DISSIPATION EQUATIONS

A. Yoshizawa *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 109-112 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

Closure models derived from the Two-Scale Direct-Interaction Approximation were compared with data from direct simulations of turbulence. Attention was restricted to anisotropic scalar diffusion models, models for the energy dissipation equation, and models for energy diffusion. Author

N88-23097*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DIRECT NUMERICAL SIMULATION OF BUOYANTLY DRIVEN TURBULENCE

William T. Ashurst (Sandia National Labs., Albuquerque, N. Mex.) and M. M. Rogers *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 117-120 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

Numerical simulations of homogeneous turbulence subject to buoyant forcing were performed. The presence of a mean temperature gradient combined with a gravitational field results in a forcing term in the momentum equations. The development of the turbulence was studied and compared to the decay of similar fields in the absence of gravity. In the buoyantly driven field, the vorticity is preferentially aligned with the intermediate eigenvector of the strain-rate tensor and the local temperature gradient is more likely to be aligned with the most compressive eigenvector. These relationships are qualitatively similar to those observed in previous shear flow results studied by Ashurst (1987). A tensor diffusivity model for passive scalar transport developed from shear flow results in Rogers, Moin, and Reynolds (1986) also predicts this buoyant scalar transport, indicating that the relationship between the scalar flux and the Reynolds stress is similar in both flows. Author

N88-23098*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PREMIXED TURBULENT FLAME CALCULATION **c25**

S. El-Tahry, C. J. Rutland, J. H. Ferziger (Stanford Univ., Calif.), and M. M. Rogers *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 121-131 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 21B

The importance of turbulent premixed flames in a variety of applications has led to a substantial amount of effort towards improving the understanding of these flames. Although these efforts have increased the understanding, many questions still remain. The use of direct numerical simulation (DNS) in solving these questions is examined. B.G.

N88-23099*# Illinois Inst. of Tech., Chicago.

MODELING OF TURBULENT TRANSPORT AS A VOLUME PROCESS

Mark J. Jennings and Thomas Morel (Integral Technologies, Inc., Northbrook, Ill.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 133-140 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

An alternative type of modeling was proposed for the turbulent transport terms in Reynolds-averaged equations. One particular implementation of the model was considered, based on the two-point velocity correlations. The model was found to reproduce the trends but not the magnitude of the nonisotropic behavior of the turbulent transport. Some interesting insights were developed concerning the shape of the contracted two-point correlation volume. This volume is strongly deformed by mean shear from the spherical shape found in unstrained flows. Of particular interest is the finding that the shape is sharply waisted, indicating preferential lines of communication, which should have a direct effect on turbulent transfer and on other processes. Author

N88-23100*# Iowa State Univ. of Science and Technology, Ames. Dept. of Chemical Engineering.

ANALYSIS OF NON-PREMIXED TURBULENT REACTING FLOWS

Andy D. Leonard and James C. Hill *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 141-146 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

Studies of chemical reactions occurring in turbulent flows are important in the understanding of combustion and other applications. Current numerical methods are limited in their applications due to the numerical resolution required to completely capture all length scales, but, despite the fact that realistic combustion cannot be solved completely, numerical simulations can be used to give insight into the interaction between the processes of turbulence and chemical reaction. The objective was to investigate the effects of turbulent motion on the effects of chemical reaction to gain some insight on the interaction of turbulence, molecular diffusion, and chemical reaction to support modeling efforts. A direct turbulence simulation spectral code was modified to include the effects of chemical reaction and applied to an initial value problem of chemical reaction between non-premixed species. The influence of hydrodynamics on the instantaneous structure of the reaction was investigated. The local scalar dissipation rates and the local reaction rates were examined to determine the influence of vorticity or rate of strain on the reaction and the structure of the scalar field. Author

N88-23101*# California Univ., Davis. Dept. of Mechanical Engineering.

A STATISTICAL INVESTIGATION OF THE SINGLE-POINT pdf OF VELOCITY AND VORTICITY BASED ON DIRECT NUMERICAL SIMULATIONS

M. Mortazavi, W. Kollmann, and K. Squires (Stanford Univ., Calif.)

In Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 147-154 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

Vorticity plays a fundamental role in turbulent flows. The dynamics of vorticity in turbulent flows and the effect on single-point closure models were investigated. The approach was to use direct numerical simulations of turbulent flows to investigate the pdf of velocity and vorticity. The preliminary study of homogeneous shear flow has shown that the expectation of the fluctuating pressure gradient, conditioned with a velocity component, is linear in the velocity component, and that the coefficient is independent of velocity and vorticity. In addition, the work shows that the expectation of the pressure gradient, conditioned with a vorticity component, is essentially zero. B.G.

N88-23102*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ON LOCAL APPROXIMATIONS OF THE PRESSURE-STRAIN TERM IN TURBULENCE MODELS
P. Bradshaw, N. N. Mansour, and U. Piomelli (Stanford Univ., Calif.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 159-164 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

The results of numerical simulations of turbulent channel flows were used to examine the validity of the local approximation of the pressure-strain term in the Reynolds stress transport equation. Outside of the viscous sublayer the local approximation compares very well with the exact pressure strain. This agreement is due, at least in part, to the high correlation between the rapid pressure and its Laplacian, which suggests that only the near parts of the flow contribute to the rapid pressure at a point. In the viscous sublayer the distance over which the mean shear can be considered constant is comparable to the length scale in the normal direction of the correlations of velocity gradients, leading to failure of the local approximation. Author

N88-23103*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LOCAL STRUCTURE OF INTERCOMPONENT ENERGY TRANSFER IN HOMOGENEOUS TURBULENT SHEAR FLOW
James G. Brasseur (Clemson Univ., S.C.) and Moon J. Lee *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 165-178 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

Intercomponent energy transfer by pressure-strain-rate was investigated for homogeneous turbulent shear flow. The rapid and slow parts of turbulent pressure (decomposed according to the influence of the mean deformation rate) are found to be uncorrelated; this finding provides strong justification for current modeling procedure in which the pressure-strain-rate term is split into the corresponding parts. Issues pertinent to scales involved in the intercomponent energy transfer are addressed in comparison with those for the Reynolds-stress and vorticity fields. A physical picture of the energy transfer process is described from a detailed study of instantaneous events of high transfer regions. It was found that the most significant intercomponent energy transfer events are highly localized in space and are imbedded within a region of concentrated vorticity. Author

N88-23104*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A GENERAL FORM FOR THE DISSIPATION LENGTH SCALE IN TURBULENT SHEAR FLOWS
J. C. R. Hunt (Cambridge Univ., England), P. R. Spalart, and N. N. Mansour *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 179-184 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

It has been found that, for a wide range of turbulent wall-bounded shear flows with mean velocity profile U(y), the scale length L-epsilon determining the dissipation is approximately described in terms of distance from the wall (y), the mean shear (dU/dy), and the variance of the normal component of turbulence (bar u-squared), by the formula: L-epsilon to the -1 power is approximately equal to (A sub B / y) + A sub S (dU/dy / square root of bar u-squared) where L-epsilon = epsilon/(bar u-squared) to the 3/2 power. To match with shear-free boundary layers, A sub B is approximately 0.27, and to match with the log layer, A sub S is approximately 0.46. The shear flows tested here were: boundary layers over a flat plate, sink flow, oscillatory flow, and channel flow. The use of the square root of bar u-squared as a velocity scale minimizes the effects of Reynolds number. However, the formula fails within a distance of order L-epsilon for the regions where dU/dy = 0. Author

N88-23105*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TEST CODE FOR THE ASSESSMENT AND IMPROVEMENT OF REYNOLDS STRESS MODELS
M. W. Rubesin, J. R. Viegas, D. Vandromme, and H. Ha Minh (Aix-Marseilles Univ., France) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 185-190 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

An existing two-dimensional, compressible flow, Navier-Stokes computer code, containing a full Reynolds stress turbulence model, was adapted for use as a test bed for assessing and improving turbulence models based on turbulence simulation experiments. To date, the results of using the code in comparison with simulated channel flow and over an oscillating flat plate have shown that the turbulence model used in the code needs improvement for these flows. It is also shown that direct simulation of turbulent flows over a range of Reynolds numbers are needed to guide subsequent improvement of turbulence models. Author

N88-23106*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
REYNOLDS STRESS MODELS OF HOMOGENEOUS TURBULENCE
T.-H. Shih, N. N. Mansour, and J. Y. Chen (Sandia National Labs., Albuquerque, N. Mex.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 191-204 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

Existing and new models for the rapid and the return terms in the Reynolds stress equations were tested in two ways. One, by direct comparison of the model with simulation data. The other, by simulating the flows using the models and comparing the predicted Reynolds stresses with the data. It was found that existing linear models can be improved and that nonlinear models are in better agreement with the simulation data for a wide variety of flows. Author

N88-23107*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE DECAY OF ISOTROPIC TURBULENCE IN A RAPIDLY ROTATING FRAME
C. G. Speziale, N. N. Mansour, and R. S. Rogallo (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 205-211 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

A direct numerical simulation of the decay of initially isotropic turbulence in a rapidly rotating frame was conducted. This 128 x

128 x 128 simulation was completed for a Reynolds number Re sub lambda = 15.3 and a Rossby number Ro sub lambda = 0.07 based on the initial turbulent kinetic energy and Taylor microscale. The numerical results indicate that the turbulence remains essentially inotropic during the major part of the decay (i.e., beyond the point where the turbulent kinetic energy has decayed to less than 10 percent of its initial value). The rapid rotation has the primary effect of shutting off the energy transfer so that the turbulence dissipation (and hence the rate of decay of the turbulent kinetic energy) is substantially reduced. Consequently, the anisotropy tensor remains essentially unchanged while the energy spectrum undergoes a nearly linear viscous decay (the same results that are predicted by Rapid Distortion Theory which is only formally valid for much shorter elapsed times. Surprisingly, no Taylor-Proudman reorganization of the flow to a two-dimensional state is observed. The implications that these results have on turbulence modeling are discussed briefly along with prospective future research. Author

N88-23108*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EVALUATION OF A THEORY FOR PRESSURE-STRAIN RATE

J. Weinstock (National Oceanic and Atmospheric Administration, Washington, D. C.) and K. Shariff *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 213-220 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

A theoretical expression for the slow part (the nonlinear fluctuation part) of the pressure-strain rate is compared with simulations of anisotropic homogeneous flows. The objective is to determine the quantitative accuracy of the theory and to test its prediction that the generalized Rotta coefficient, a non-dimensionalized ratio of slow term to the Reynolds stress anisotropy, varies with direction and can be negative. Comparisons are made between theoretical and simulation values of the slow term itself and of the generalized Rotta coefficients. The implications of the comparison for two-point closure theories and for Reynolds stress modeling are pointed out. Author

N88-23109*# Israel Inst. of Tech., Haifa.

RELATIONS BETWEEN TWO-POINT CORRELATIONS AND PRESSURE STRAIN TERMS

Micha Wolfshtein and Sanjiva K. Lele (Stanford Univ., Calif.) *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 221-230 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

The structure of the two-point spatial correlations (velocity-velocity, velocity-scalar, and scalar-scalar) were studied with a view to improve turbulence closure models. The linear model for the two-point correlations proposed by Naot provides a method of including the information about the turbulence structure in the turbulence models. The assumptions and adequacy of this model were tested against the homogeneous shear flow simulation data base. The model performs poorly in some details and it is suggested how it may be improved. The models were also tested for rapid pressure-strain terms in a variety of flows including axisymmetric expansion and contraction flows, homogeneous shear flow, channel flow, and boundary layer. Author

N88-23110*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

SHEAR-LAYER STRUCTURES IN NEAR-WALL TURBULENCE

A. V. Johansson, P. H. Alfredsson (Royal Inst. of Tech., Stockholm, Sweden), and J. Kim *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 237-251 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

The structure of internal shear layer observed in the near-wall region of turbulent flows is investigated by analyzing flow fields obtained from numerical simulations of channel and boundary-layer flows. It is found that the shear layer is an important contributor to the turbulence production. The conditionally averaged production at the center of the structure was almost twice as large as the long-time mean value. The shear-layer structure is also found to retain its coherence over streamwise distances on the order of a thousand viscous length units, and propagates with a constant velocity of about 10.6 u sub rho throughout the near wall region. Author

N88-23111*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THE SIMULATION OF COHERENT STRUCTURES IN A LAMINAR BOUNDARY LAYER

Kenny Breuer, Marten T. Landahl (Massachusetts Inst. of Tech., Cambridge.), and Philippe R. Spalart *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 253-261 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

Coherent structures in turbulent shear flows were studied extensively by several techniques, including the VITA technique which selects rapidly accelerating or decelerating regions in the flow. The evolution of a localized disturbance in a laminar boundary layer shows strong similarity to the evolution of coherent structures in a turbulent-wall bounded flow. Starting from a liftup-sweep motion, a strong shear layer develops which shares many of the features seen in conditionally-sampled turbulent velocity fields. The structure of the shear layer, Reynolds stress distribution, and wall pressure footprint are qualitatively the same, indicating that the dynamics responsible for the structure's evolution are simple mechanisms dependent only on the presence of a high mean shear and a wall and independent of the effects of local random fluctuations and outer flow effects. As the disturbance progressed, the development of streak-like-high- and low-speed regions associated with the three-dimensionality. Author

N88-23112*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CONDITIONALLY-AVERAGED STRUCTURES IN WALL-BOUNDED TURBULENT FLOWS

Yann G. Guezennec, Ugo Piomelli (Stanford Univ., Calif.), and John Kim *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 263-272 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

The quadrant-splitting and the wall-shear detection techniques were used to obtain ensemble-averaged wall layer structures. The two techniques give similar results for Q4 events, but the wall-shear method leads to smearing of Q2 events. Events were found to maintain their identity for very long times. The ensemble-averaged structures scale with outer variables. Turbulence producing events were associated with one dominant vortical structure rather than a pair of counter-rotating structures. An asymmetry-preserving averaging scheme was devised that allowed a picture of the average structure which more closely resembles the instantaneous one, to be obtained. Author

N88-23113*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

STRUCTURE OF TURBULENT SHEAR FLOWS

A. K. M. F. Hussain, J. Jeong (Houston Univ., Tex.), and J. Kim *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 273-290 (For primary document see N88-23086 16-34)

Avail: NTIS HC A14/MF A01 CSCL 20D

Activities are summarized for each of the three topics discussed: eduction of coherent structures; measurement of propagation velocities of perturbation in turbulent flows; and direct evaluation of the Taylor hypothesis. B.G.

N88-23114*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
INFLECTIONAL INSTABILITIES IN THE WALL REGION OF BOUNDED TURBULENT SHEAR FLOWS
Jerry D. Swearingen, Ron F. Blackwelder (University of Southern California, Los Angeles.), and Philippe R. Spalart *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 291-295 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

The primary thrust of this research was to identify one or more mechanisms responsible for strong turbulence production events in the wall region of bounded turbulent shear flows. Based upon previous work in a transitional boundary layer, it seemed highly probable that the production events were preceded by an inflectional velocity profile which formed on the interface between the low-speed streak and the surrounding fluid. In bounded transitional flows, this unstable profile developed velocity fluctuations in the streamwise direction and in the direction perpendicular to the sheared surface. The rapid growth of these instabilities leads to a breakdown and production of turbulence. Since bounded turbulent flows have many of the same characteristics, they may also experience a similar type of breakdown and turbulence production mechanism. Author

N88-23115*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACTIVE LAYER MODEL FOR WALL-BOUNDED TURBULENCE
M. T. Landahl (Massachusetts Inst. of Tech., Cambridge.), J. Kim, and P. R. Spalart *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 297-302 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

The active-layer model for wall-bounded turbulence hypothesizes that the nonlinear terms are large only in a thin layer near the wall, and hence the turbulence in the region outside the active inner layer can be modeled as a linear fluctuating flow driven by the active layer. This hypothesis is tested using data obtained from a direct simulation of turbulent channel flow. It is found that the nonlinear effects are the strongest near the wall with a maximum at around y sup + = 20 and, outside the near-wall region, these involve primarily the cascading mechanism leading to dissipation. Author

N88-23116*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WAVE-GROWTH ASSOCIATED WITH TURBULENT SPOT IN PLANE POISEUILLE FLOW
D. S. Henningson, M. T. Landahl (Massachusetts Inst. of Tech., Cambridge.), and J. Kim *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 303-310 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

A kinematic wave theory is used to investigate the cause of the rapid growth of waves observed at the wingtip of turbulent spot in plane Poiseuille flow. It is found that the qualitative behavior of the wave motions is well described by Landahl's breakdown criterion as the wave selection procedure. The predicted wave number, wave angle, and phase velocity are in agreement with those values obtained in a direct simulation. Author

N88-23117*# Imperial Coll. of Science and Technology, London (England).
COHERENT STRUCTURE
Peter Bradshaw *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 313-314 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

The mental picture of turbulence structure had progressed from the hypothesis that it mimics molecular motion to the belief that turbulence is highly organized. The history of turbulence structure is briefly reviewed. B.G.

N88-23118*# Cambridge Univ. (England).
COHERENT STRUCTURES: COMMENTS ON MECHANISMS
J. C. R. Hunt *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 315-322 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

There is now overwhelming evidence that in most turbulent flows there exist regions moving with the flow where the velocity and vorticity have a characteristic structure. These regions are called coherent structures because within them the large-scale distributions of velocity and/or vorticity remain coherent even as these structures move through the flow and interact with other structures. Since the flow enters and leaves the bounding surfaces of these structures, a useful definition for coherent structures is that they are open volumes with distinctive large-scale vorticity distributions. Possible fruitful directions for the study of the dynamics of coherent structures are suggested. Most coherent structures research to data was concentrated on measurement and kinematical analysis; there is now a welcome move to examine the dynamics of coherent structures, by a variety of different methods. A few of them will be described. Author

N88-23119*# Universidad Politecnica de Madrid (Spain).
COHERENT STRUCTURES AND DYNAMICAL SYSTEMS
Javier Jimenez *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 323-324 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

Any flow of a viscous fluid has a finite number of degrees of freedom, and can therefore be seen as a dynamical system. A coherent structure can be thought of as a lower dimensional manifold in whose neighborhood the dynamical system spends a substantial fraction of its time. If such a manifold exists, and if its dimensionality is substantially lower that that of the full flow, it is conceivable that the flow could be described in terms of the reduced set of degrees of freedom, and that such a description would be simpler than one in which the existence of structure was not recognized. Several examples are briefly summarized. B.G.

N88-23120*# Stanford Univ., Calif.
COHERENT STRUCTURES AND MODELING: SOME BACKGROUND COMMENTS
S. J. Kline *In its* Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 325-328 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

Coherent structures are discussed as a sequence of events (identifiable motions) in the flow which convert significant amounts of mechanical energies of the mean flow stream, into turbulent fluctuations. The use of structure information in modeling is also discussed. B.G.

N88-23121*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COHERENT STRUCTURES
Charles G. Speziale *In* Stanford Univ., Studying Turbulence Using Numerical Simulation Databases. Proceedings of the 1987 Summer Program Dec. 1987 p 329-330 (For primary document see N88-23086 16-34)
Avail: NTIS HC A14/MF A01 CSCL 20D

In order to develop more quantitative measures of coherent structures that would have comparative value over a range of experiments, it is essential that such measures be independent of the observer. It is only through such a general framework that theories with a fundamental predictive value can be develope.

The triple decomposition phi = bar-phi + phi(c) + phi(r) (where bar-phi is the mean, phi(c) is the coherent part, and phi(r) is the random part of any turbulent field phi) serves this purpose. The equations of motion for the mean and coherent flow fields, based on the triple decomposition, are presented and modeling methods for the time-averaged and phase-averaged Reynolds stress are discussed. M.G.

N88-23122*# Old Dominion Univ., Norfolk, Va.
SECONDARY INSTABILITY OF COMPRESSIBLE BOUNDARY LAYER TO SUBHARMONIC THREE-DIMENSIONAL DISTURBANCES
Nabil M. El-Hady Washington NASA [1988] 30 p (Grant NAG1-729)
(NASA-CR-4144; NAS 1.26:4144) Avail: NTIS HC A03/MF A01 CSCL 20D

Three-dimensional linear secondary instability theory is extended for compressible boundary layers on a flat plate in the presence of finite amplitude Tollmien-Schlichting (T-S) waves. The focus is on principal parametric resonance responsible for the strong growth of harmonics in a low disturbance environment. Author

N88-23123# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
CALORIMETRIC TECHNIQUE FOR MEASURING LIQUID HELIUM FLOW RATE
A. I. Ageev, Yu. G. Bozhko, and A. V. Zhirnov 1986 10 p In RUSSIAN; ENGLISH summary
(DE88-701308; IFVE-OUNK-86-226) Avail: NTIS (US Sales Only) HC A02/MF A01

A calorimetric method for measuring liquid helium flow rate is treated. The system is implied for measuring single phase helium ranging from 3 to 50 g/s. The main measuring error is six percent. The flowmeters design, measuring apparatus and software are described. The influence of the measured parameters errors on the accuracy of helium flow rate measuring was analyzed. DOE

N88-23124# Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods.
PECULIARITIES OF NON-STATIONARY HEAT TRANSFER TO SUPERFLUID HELIUM
V. M. Miklyaev, I. A. Sergeev, and Yu. P. Fillipov 1987 10 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE88-701174; JINR-R-8-87-33) Avail: NTIS (US Sales Only) HC A02/MF A01

The experimental results of investigation of heat transfer from cylindrical sample into volume of superfluid helium under step power input conditions are presented. In comparison with He(I) the He(II) peculiarities are enlisted and discussed: comparatively short time of stationary heat transfer rate establishment and comparatively long time of crisis reaching. Under certain conditions the qualitatively new data are obtained: the region of transitions, which include the peaks of heat transfer surface superheating and the following crisis rapid reaching. The mechanism of processes registered is discussed: superfluid turbulence, the phase transitions He(II) greater than He(I), He(I) greater than vapor He as well, the interaction between the produced He(I) phase and He(II) volume. DOE

N88-23125# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
AERODYNAMIC AND RELATED HYDRODYNAMIC STUDIES USING WATER FACILITIES
Jun. 1987 462 p In ENGLISH and FRENCH Symposium held in Monterey, Calif., 20-23 Oct. 1986 Original contains color illustrations
(AGARD-CP-413; ISBN-92-835-0419-4) Avail: NTIS HC A20/MF A01

Related problems, experiences and advancements in aeronautical and maritime fluid dynamics through the use of water facilities are reviewed. In recent years there has been an increasing use of water facilities for aerodynamic investigations. These include water tunnels, towing channels, and stationary tanks. Examples include basic research problems as well as flow fields around fighter aircraft, inlet flows, recirculation flow patterns associated with VTOL, ramjet simulation, etc., and, in general, 3-D flows with vortices or separated regimes as prominent features. The Symposium was organized to provide an appropriate forum for the exchange of information within the aeronautical and maritime fluid dynamics community. For individual titles, see N88-23126 through N88-23157.

N88-23126*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WATER FACILITIES IN RETROSPECT AND PROSPECT: AN ILLUMINATING TOOL FOR VEHICLE DESIGN **c09**
Gary E. Erickson, David J. Peake, John DelFrate, Andrew M. Skow, and Gerald N. Malcolm (Eidetics International, Inc., Torrance, Calif.) *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 28 p Previously announced as N87-13403 (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01 CSCL 14B

Water facilities play a fundamental role in the design of air, ground, and marine vehicles by providing a qualitative, and sometimes quantitative, description of complex flow phenomena. Water tunnels, channels, and tow tanks used as flow-diagnostic tools have experienced a renaissance in recent years in response to the increased complexity of designs suitable for advanced technology vehicles. These vehicles are frequently characterized by large regions of steady and unsteady 3-D flow separation and ensuing vortical flows. The visualization and interpretation of the complicated fluid motions about isolated vehicle components and complete configurations in a time and cost effective manner in hydrodynamic test facilities is a key element in the development of flow control concepts, and, hence, improved vehicle designs. A historical perspective of the role of water facilities in the vehicle design process is presented. The application of water facilities to specific aerodynamic and hydrodynamic flow problems is discussed, and the strengths and limitations of these important experimental tools are emphasized. Author

N88-23127*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VORTEX BREAKDOWN AND CONTROL EXPERIMENTS IN THE AMES-DRYDEN WATER TUNNEL
F. K. Owen (Complere, Inc., Palo Alto, Calif.) and D. J. Peake *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 10 p Previously announced as N87-13409 (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01 CSCL 20D

Flow-field measurements have been made to determine the effects of core blowing on vortex breakdown and control. The results of these proof-of-concept experiments clearly demonstrate the usefulness of water tunnels as test platforms for advanced flow-field simulation and measurement. Author

N88-23128# Societe Bertin et Cie, Plaisir (France).
QUALIFICATION OF A WATER TUNNEL FOR FORCE MEASUREMENTS ON AERONAUTICAL MODELS [QUALIFICATION DUN TUNNEL HYDRODYNAMIQUE POUR DES PESEES DE MAQUETTES AERONAUTIQUES] **c09**
B. Chezlepretre and Y. Brocard *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 15 p In FRENCH; ENGLISH summary (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Bertin and Company maintains a water tunnel where flow visualization, and velocity and force measurements are performed. Recently, force measurements were done on a wing-canard model which was also tested in a wind tunnel at ONERA. This paper focuses on the presentation of the facility (including its laser anemometer and the computerized data acquisition system) and on the satisfactory comparison of the balance measurements obtained in both water and wind tunnels. Author

N88-23129# Tracor Hydronautics, Inc., Laurel, Md.
AN EXPERIMENTAL STUDY TO DETERMINE THE FLOW AND THE SUBSONIC STATIC AND DYNAMIC STABILITY CHARACTERISTICS OF AIRCRAFT OPERATING AT HIGH ANGLES-OF-ATTACK c05
Alex Goodman and Clinton E. Brown *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 28 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

A comprehensive series of experiments was conducted in the Tracor Hydronautics Ship Model Basin (HSMB) to determine the subsonic static and dynamic stability characteristics of a 3.5-foot span, 60-deg delta-high-wing fuselage model operating at high angles-of-attack up to 68 deg. In addition, typical results of flow visualization studies for a range of Reynolds numbers from 0.2 to 1.6 x 10 to the 6th, are presented. Also, the motions, force and moment coefficients resulting from a simulated pitchup maneuver are presented. Described is the HSMB Large Amplitude Horizontal Planar Motion Mechanism System (LAHPMM), 60-deg delta-wing-fuselage model, model-support systems, and the data acquisition and processing system used. The advantages of performing tests in the HSMB using the LAHPMM technique over existing wind tunnel techniques, such as curved flow and combined oscillation, for determination of the dynamic stability derivatives are presented and discussed. Results compare favorably with earlier (1950) tests of a similar configuration at angles of attack up to 32 deg. Author

N88-23130# Eidetics International, Inc., Torrance, Calif.
FLOW VISUALIZATION STUDY OF VORTEX MANIPULATION ON FIGHTER CONFIGURATIONS AT HIGH ANGLES OF ATTACK
Gerald N. Malcolm and Andrew M. Skow *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 19 p (For primary document see N88-23125 16-34)
(Contract F33615-85-C-3619)
Avail: NTIS HC A20/MF A01

Experiments were performed in a flow visualization water tunnel on a generic fighter model to explore vortex manipulation as an effective means of aircraft control by altering the natural state of the forebody and LEX vortices in the medium-to-high-angle of attack range with either small surface modifiers or blowing jets. Specifically, the forebody vortex system was examined with the clean forebody, with forebody strakes, and with forebody surface blowing. LEX vortices were examined with a clean LEX, with small geometric modifications near the apex, and with surface blowing, both in upstream and downstream directions at various locations on the LEX surface. The interactive effects of forebody and LEX/wing vortices and their response to the various methods of control were also examined. It was concluded that the forebody vortices can be effectively controlled by either blowing or using strakes, but the effectiveness is very dependent on proper radial placement of the blowing port or strake. Author

N88-23131# Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.
OSCILLATING FLOW OVER BLUFF BODIES IN A U-SHAPED WATER TUNNEL
Turgut Sarpkaya *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 15 p (For primary document see N88-23125 16-34)
(Grant NSF CEE-82-10246)
Avail: NTIS HC A20/MF A01

Studies dealing with sinusoidally oscillating separated and unseparated flows over various types of bluff bodies are described. First, the characteristics of a large U-shaped vertical water tunnel are described and then the numerical and experimental results obtained with circular cylinders are presented. It is shown that for 2-D, attached, and laminar-flow conditions the data are, as expected, in good agreement with the previous analysis. The oscillatory viscous flow becomes unstable to axially periodic Taylor-Goertler vortices above a critical Keulegan-Carpenter number K (K=U sub mT/D) for a given Beta (Beta = D sup 2/upsilonT). For larger values of K the effects of separation and vortex shedding become increasingly important, eventually leading to a very interesting half Karman vortex street in the transverse direction in the range 8 less than K less than 13. The discrete vortex model of the separated oscillating flow is shown to provide a reasonably satisfactory explanation of the transverse vortex street. Finally, an attempt is made, through the use of an ideal vortex model, to explain the observed flow modes and the cycle-to-cycle variations in forces and pressures in terms of their sensitivity to small stochastic variations in the position of the vortices. Author

N88-23132# National Research Council of Canada, Ottawa (Ontario). Low Speed Aerodynamics Lab.
THE USE OF THE NRC/NAE WATER FACILITIES IN CANADIAN AERONAUTICAL RESEARCH AND DEVELOPMENT c09
R. H. Wickens and N. E. Jeffreys *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 20 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Described are some of the hydrodynamic facilities of the National Research Council in Ottawa and St. John's, Newfoundland. The NAE water tunnel, in particular, contributed to the understanding of the aerodynamics of various VSTOL concepts, and complex flows containing strong elements of vorticity and unsteadiness. Several projects are described in which fundamental flow observations were made, and from which data was obtained in support of theoretical investigations. The past and future potential of several water facilities of the NRC for pursuing aeronautical and marine research are described. Author

N88-23133# MATRA Service Aerodynamique, Velizy-Villacoublay (France).
DESCRIPTION OF A WATER TANK FACILITY: STUDY OF A MISSILE AT HIGH INCIDENCE [PRESENTATION DUN BASSIN HYDRODYNAMIQUE: ETUDE DUN MISSILE AUX GRANDES INCIDENCES] c09
J. Perinelle and A. Lupieri *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 20 p In FRENCH; ENGLISH summary (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

The water tank facility at Matra in which measurements are done of flows past missiles and other related research performed, is described. To assess the experimental techniques used, comparisons are made with wind tunnel test results. In terms of flow visualization, the phenomenon of vortex breakdown on a delta wing at incidence is checked against those of other installations. In addition, the characteristics of a simplified missile configuration are considered in subsonic flow at large incidences. The emphasis here is on two aspects: (1) the occurrence of side forces for angles of attack beyond a certain value, and how it is possible to correlate wind tunnel tests with the visualization of such flows; and (2) using wind tunnel data obtained with an instrumented model with a wing mounted on a balance compared with three other wings fixed to the body, a new correlation between measurements and visualization is made, indicating the strong dependency of wing lift on missile roll angle attitude. Author

N88-23134# Technische Hochschule, Aachen (West Germany).
SHORT DURATION FLOW ESTABLISHMENT ON A PROFILE IN A WATER-LUDWIEG-TUNNEL
W. Kerres and H. Groenig *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 12 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

This paper deals with the time-dependent establishment of the flow field on an airfoil in unsteady flow. The impulsive part of the flow is achieved in a Water-Ludwieg-Tunnel. By using a coded particle tracing method for flow visualization, the detailed flow establishment on a NACA 0012 airfoil at 30-deg angle of attack

is shown from the beginning where potential flow exists with zero circulation to a quasi-steady formation of the vortex street.
Author

N88-23135# McDonnell-Douglas Research Labs., St. Louis, Mo.
EXPERIMENTAL INVESTIGATION OF HOVER FLOWFIELDS IN WATER AT THE MCDONNELL DOUGLAS RESEARCH LABORATORIES
K. R. Saripalli, J. C. Kroutil, and J. R. VanHorn *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 10 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

A new experimental facility, the Hover Research Facility (HRF), is designed to study the flowfields generated by hovering vertical takeoff and landing (VTOL) aircraft and helicopters. Water is used as the working medium because of its inherent advantages in flow visualization and laser Doppler velocimeter (LDV) measurements. The applications of the Hover Research Facility include: (1) experimental investigation of twin-jet impingement flow with application to VTOL aircraft; (2) visualization of the flowfield around a fully contoured, model supersonic fighter/attack short takeoff and vertical landing (STOVL) aircraft; and (3) performance testing of a No Tail Rotor (NOTAR) helicopter in hover mode by use of a scale model. Flow visualization and quantitative LDV data on these experiments are presented. Author

N88-23136# Instituto Superior Tecnico, Lisbon (Portugal). Dept. of Mechanical Engineering.
AN INVESTIGATION OF DUCTED PROPELLERS IN AXISYMMETRIC SHEAR FLOW
J. A. C. FalcaodeCampos *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 15 p Sponsored in part by Instituto Superior Tecnico (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

To improve the basic understanding of the complex interaction flow phenomena between ducted propeller systems and a ship's hull, the effects of radial nonuniformity of the inflow to the ducted propeller were investigated, both numerically and experimentally. The mathematical model is based on the Euler equations for an inviscid, incompressible axisymmetric flow and on the representation of the propeller by an actuator disk. In a vorticity-stream function formulation, the problem is governed by two coupled integral equations, which express vorticity transport in the flow and the boundary conditions on the duct and hub surfaces. The numerical solution method employs a discretization of the vorticity field into vortex sheets, which are traced iteratively in a fixed grid. The problem was also experimentally investigated in the Large Cavitation Tunnel of the Maritime Research Institute of the Netherlands. A five-bladed propeller model, placed inside a duct, was tested behind wire screens, generating a wake velocity profile with axial symmetry. Laser-Doppler measurements of mean axial and radial velocities were carried out at various axial locations upstream and downstream of the ducted propeller. Detailed comparisons between the results of calculations and the experiments are presented and discussed. Author

N88-23137# Leicester Univ. (England). Dept. of Engineering.
MEASUREMENTS OF AERODYNAMIC FORCES ON UNSTEADILY MOVING BLUFF PARACHUTE CANOPIES
D. J. Cockrell, R. J. Harwood, and C. Q. Shen *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 7 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Equations which describe the unsteady motion of bluff bodies through fluids contain certain components, termed added mass coefficients, which can only be determined by experiment. From the solutions to such equations the ways in which the shapes of parachute canopies influence the frequency of their oscillatory motion in pitch and their corresponding damping rates are required. Although a full-scale parachute canopy descends through air, oscillating in pitch as it does, experiments necessary to determine these added mass coefficients have been performed under water, using for this purpose a large ship tank from the towing carriage of which the model parachute canopies were suspended. These experiments showed that the added mass coefficients for bluff parachute canopies differed appreciably from their corresponding potential flow values. The latter were obtained from the analysis of inviscid, fluid flow around regular shapes which were representative of those parachute canopies. The significance for the prediction of the parachute's dynamic behavior in pitch is outlined. Author

N88-23138# IMI Summerfield, Kidderminster (England).
WATER FLOW VISUALISATION OF A RAMROCKET COMBUSTION CHAMBER
P. J. Boszko and G. S. Owen *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 11 p Sponsored in part by Ministry of Defence (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Flow within the combustion chamber of a ramrocket has been investigated using water flow visualization with air bubbles as tracers. Configurations with four axisymmetric intakes entering the combustion chamber at either 45 or 90 deg have been considered. A region of stable recirculatory flow has been identified at the head end of the combustion chamber and estimates have been obtained of the amount flowing through the recirculation region. Based on this information fuel jets have been designed which it is believed will aid ignition, secure flame stability, and improve combustion efficiency. The interaction between fuel jets and the recirculatory air flow has been tentatively investigated on flow visualization tests using jets of colored water. Author

N88-23139# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
THE ONERA WATER TUNNELS TEST POSSIBILITIES FOR FLOW VISUALIZATION IN AERONAUTICAL AND NAVAL DOMAINS
H. Werle *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 16 p In FRENCH; ENGLISH summary (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

The ONERA water test tunnels, which for a long time were the pioneers in flow visualization, cover a broad scope of test methods and means, encompassing a wide field of applications. This paper presents an up-to-date description of the experimental techniques used for plane, axisymmetric and three-dimensional flow, and gives a survey of the most notable results achieved in domains as varied as fundamental research and aerodynamics and related hydrodynamic studies. Author

N88-23140# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. for Experimental Fluid Mechanics.
THE USE OF A WATER TOWING TANK FOR AERODYNAMIC TESTING AND METHODS FOR QUANTITATIVE EVALUATION OF PHOTOGRAPHS
H. Bippes *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 11 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

The use of the water towing tank of the DFVLR for fluid dynamic testing is briefly described. The capability of measuring techniques is discussed. Among the various techniques the quantitative evaluation of photographs of visualized flow proved to be most effective for use in a water towing tank. Two methods enabling the survey of 3-D flow fields are dealt with in detail. The first method based on photogrammetric techniques has already been applied to the investigation of 3-D disturbances in an unstable laminar boundary layer and to the study of a free vortex flow. The second one is based on holographic techniques. Its feasibility for supplying quantitative data is discussed. Author

N88-23141*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLOW MEASUREMENTS IN A WATER TUNNEL USING A HOLOCINEMATOGRAPHIC VELOCIMETER
Leonard M. Weinstein and George B. Beeler *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 7 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01 CSCL 20D

Dual-view holographic movies were used to examine complex flows with full three-space and time resolution. This approach, which tracks the movement of small tracer particles in water, is termed holocinematographic velocimetry (HCV). A small prototype of a new water tunnel was used to demonstrate proof-of-concept for the HCV. After utilizing a conventional flow visualization apparatus with a laser light sheet to illuminate tracer particles to evaluate flow quality of the prototype tunnel, a simplified version of the HCV was employed to demonstrate the capabilities of the approach. Results indicate that a full-scale version of the water tunnel and a high performance version of the HCV should be able to check theoretical and numerical modeling of complex flows and examine the mechanisms operative in turbulent and vortex flow control concepts, providing an entirely unique instrument capable, for the first time, of simultaneous three-space and time measurements in turbulent flow. Author

N88-23142# Centre d'Etudes et de Recherches, Toulouse (France). Dept. dEtudes en Mecanique et Energetique des Systemes.
EXPERIMENTAL STUDY OF VORTEX SHEETS IN PLANE FLOW [ETUDE EXPERIMENTALE DE NAPPES TOURBILLONNAIRES EN ECOULEMENT PLAN]
Christian Berger, Magali Bourgeois, Gerard Lavergne, Christine Lempereur, and Jean-Michel Mathe *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 7 p In FRENCH (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

With the aim of conducting an experimental study of shear instability in laminar flow, a vertical water tank was designed which would generate a confluence of two bi-dimensional flows of different velocities. The study consisted of characterizing the instabilities developing downstream from the base starting with the determination of velocity profiles with laser anemometry and various flow visualization and image processing techniques. The Reynolds number calculated across the width of the base and the mean of the two velocities is less than 600. Modeling this type of flow with the aid of vortex sheets emitted at the base extremities permits the construction of emission lines comparable to those observed. Author

N88-23143# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
THREE-DIMENSIONAL FLOW VISUALIZATION USING LASER-SHEET SCANNING
D. M. Nosenchuck and M. K. Lynch *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 13 p (For primary document see N88-23125 16-34)
(Contract N00014-85-K-0352; Grant NSF MSM-83-52175)
Avail: NTIS HC A20/MF A01

It has been demonstrated that the conventional technique of fixed-laser-sheet flow visualization can be extended to include 3-D visualization by means of a scanning laser sheet. This system was implemented using a rotating mirror in conjunction with appropriate fixed optics. A space-filling 3-D data base was digitally obtained from the imaging and recording units, and was processed to yield a variety of 3-D views of the flow field in addition to obtaining quantitative results regarding mixing levels and velocities. Laser-sheet scanning was first applied in a study of boundary-layer turbulence in which active control was implemented. The flow visualization readily indicated the near-wall instabilities present in turbulent spots and synthetic turbulent boundary layers. When control was attempted using an array of surface heating elements, the visualization technique graphically illustrated the attenuation of the near-wall sublayer streaks and resultant quiescent outer flow. Author

N88-23144# Institut de Mecanique des Fluides de Lille (France).
APPLICATION OF HIGH SPEED HOLOGRAPHY TO AERODYNAMIC AND HYDRODYNAMIC THREE-DIMENSIONAL VELOCIMETRY
M. Stanislas, O. Rodriguez, M. Dadi, and F. Beluche *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 10 p Sponsored in part by French Ministery for Defense (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

The application of holography to the measurement of fluid velocity in 3-D domains is proposed. After a short description of the method, an example of application to the water flow around a circular cylinder at low Reynolds number is presented. Then, the main limitations of the method are discussed and solutions proposed to overcome them. Author

N88-23145# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mechanical and Aerospace Engineering and Chemical Engineering.
MATCHED INDEX LASER ANEMOMETRY SYSTEMS FOR FLOW STUDIES IN COMPLEX GEOMETRIES c35
A. Dybbs, R. V. Edwards, and E. Reshotko *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 18 p Sponsored in part by Case Center for Complex Flow Measurements, C3FM (For primary document see N88-23125 16-34)
(Contract N00014-84-K-0294; Grant NSF CME-79-13389)
Avail: NTIS HC A20/MF A01

Optical access to the flow is necessary if laser anemometry is to be used to map a given flow field. Often this access is difficult or impossible to obtain because of the shape of the object about which (or within which) the flow exists. Examples are flows in porous media, fluidized beds, heat exchangers, or near sinusoidal surfaces. Making the object of transparent material such as of glass or plexiglas is not sufficient to provide a reliable, useable optical environment for laser measurements. It is often necessary to use a fluid whose index or refraction matches that of the object. Author

N88-23146# Universite de Valenciennes et du Hainaut-Cambresis (France). Lab. de Mecanique des Fluides.
WATER TUNNEL MEASUREMENTS BY AN ELECTROCHEMICAL METHOD [MESURES EN TUNNEL HYDRODYNAMIQUE PAR METHODE ELECTROCHIMIQUE]
C. Tournier and P. Florent *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 14 p In FRENCH (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

A polarographic method to measure parietal friction is described. With the proper liquid, the technique permits the measurement of 3-D and unsteady flows without perturbations. To employ the method, a large capacity water tank (Re - 1.5 x 10 to the 6th) made entirely of electrically neutral and chemically inert materials was designed. Sample measurements made using the polarographic method are presented. They were selected to illustrate the advantages of this method in typical cases of 3-D or unsteady flows. The possibility of measuring mass transfer using this method is also discussed. Author

N88-23147# California Univ., San Diego, La Jolla.
FLOW VELOCITY MEASUREMENTS BY IMAGE PROCESSING OF OPTICALLY MODULATED TRACES
M. Gharib, B. Dyne, O. Thomas, and C. Yap *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 7 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

A computerized flow visualization technique capable of quantifying the flow field automatically is described. The technique uses a time modulated illumination scheme to retrieve vectorial information from the pathlines of particles suspended in the flow. This technique has eliminated a major source of error in velocity reading which is common in conventional particle tracing techniques. Application of the present technique to the recirculating flow field of a 2-D cavity is described. Velocity profiles obtained from the pathlines of the particles through the present techniques show excellent agreement with the velocity profiles obtained using laser Doppler velocimetry. Author

N88-23148# Florida State Univ., Tallahassee.
A NON-INVASIVE EXPERIMENTAL TECHNIQUE FOR THE MEASUREMENT OF UNSTEADY VELOCITY AND VORTICITY FIELDS
L. Lourenco, A. Krothapalli, J. M. Buchlin, and M. L. Riethmuller (Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese, Belgium) *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 9 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

A new velocity measurement technique is described which provides the simultaneous visualization of a 2-D streamline pattern and the quantification of the velocity field. The main advantage of this technique is that the velocity field can be measured with sufficient accuracy and spatial resolution so that the vorticity field can be readily obtained. This technique is ideally suited for the study of unsteady vertical flows, which occur in high angle of attack aerodynamics. The technique, some of the important parameters affecting its use, and some recent examples are described. Author

N88-23149*# Notre Dame Univ., Ind. Dept of Aerospace and Mechanical Engineering.
USE OF WATER TOWING TANKS FOR AERODYNAMICS AND HYDRODYNAMICS
Mohamed GadelHak *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 11 p (For primary document see N88-23125 16-34)
(Contracts NAS1-18292; NAS1-18213; N00014-81-C-0453; F49620-82-C-0020; Grant NSF ISI-85-60825)
Avail: NTIS HC A20/MF A01 CSCL 20D

Wind tunnels and flumes have become standard laboratory tools for modeling a variety of aerodynamic and hydrodynamic flow problems. Less available, although by no means less useful, are facilities in which a model can be towed (or propelled) through air or water. This article emphasizes the use of the water towing tank as an experimental tool for aerodynamic and hydrodynamic studies. Its advantages and disadvantages over other flow rigs are discussed, and its usefulness is illustrated through many examples of research results obtained over the past few years in a typical towing tank facility. Author

N88-23150# Stuttgart Univ. (West Germany). Inst. fuer Aerodynamik und Gasdynamik.
A NEW LAMINAR WATER TUNNEL TO STUDY THE TRANSITION PROCESS IN A BLASIUS LAYER AND IN A SEPARATION BUBBLE AND A NEW TOOL FOR INDUSTRIAL AERODYNAMICS AND HYDRODYNAMIC RESEARCH c09
M. Strunz and J. F. Speth *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 5 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Two new watertunnels of the Institute for Aerodynamics and Gas Dynamics of the University of Stuttgart are presented. The first is especially designed to study the stability of a laminar boundary layer. The second was built to solve problems in industrial aero- and hydrodynamics. Both tunnels are constructed of corrosion-resistant materials, i.e., fiberglas/reinforced plastic technology. Technical data and the first applications are discussed. Author

N88-23151# British Aerospace Public Ltd. Co., Bristol (England). Aerodynamics Research Dept.
A COMPARATIVE STUDY OF VORTEX FLOWS IN WIND AND WATER TUNNELS
A. G. Davies *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 16 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Characteristics of the flowfield around a generalized missile configuration using two flow visualization techniques in a water tunnel are compared to corresponding wind tunnel data at subsonic and supersonic speeds. It is shown that the flowfields derived from the water tunnel can be representative of those found at subsonic speeds although isolated body vortex locations agree more with those measured at supersonic speeds and that separation angles on the body can be important. The addition of a cruciform set of fins is shown to modify the body vortex structure dramatically, the degree of modification varying with axial location of the fins. A speed effect is seen to exist in the water tunnel that can change some vortex flowfield characteristics from those of a subsonic flow to those observed at supersonic speeds. Finally, cross flow velocities and circulations are compared between water and wind tunnels. Author

N88-23152# Saab-Scania, Linkoping (Sweden).
INVESTIGATION ON THE MOVEMENT OF VORTEX BURST POSITION WITH DYNAMICALLY CHANGING ANGLE OF ATTACK FOR A SCHEMATIC DELTAWING IN A WATERTUNNEL WITH CORRELATION TO SIMILAR STUDIES IN WINDTUNNEL
Karl W. Wolffelt *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 8 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

The requirements for modern military aircraft to maintain good handling qualities at very high angles of attack is one of many reasons why an increased knowledge is necessary regarding the aerodynamic behavior of vortex flows at nonstationary conditions. Linearized theory as it has been utilized in flight mechanics simulation using damping derivatives derived from forced oscillation technique, for example, may no longer be valid at such conditions. With this background some investigations have been made by SAAB-SCANIA with the aim to study the hysteresis effects for nonstationary vortex flows. A schematic delta-wing model which could also be equipped with a similar canard wing has been tested in a water tunnel. The model was supported in the tunnel by a simple mechanism by which it could be forced to move in one of four different modes, pitching or plunging with either ramp or harmonic motion. The flow over the model was visualized with air bubbles and sequences were recorded on videotape. The sequences were analyzed and the movements of the leading edge vortex burst have been studied with the main interest focused on the hysteresis effects. Author

N88-23153# Technische Hogeschool, Eindhoven (Netherlands).
SOME VISUALIZATION STUDIES ON TURBULENT BOUNDARY LAYERS USING MULTIWIRE HYDROGEN BUBBLE GENERATION
R. Blokland and K. Krishna Prasad *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 12 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Provided are new results obtained using two visualization methods which assist in describing essentially three dimensional phenomena: (1) With two wire pattern correlation the flow field can be described in a large set of sections through a certain structure; (2) Multiple color illumination allows recognition of movements in a direction normal to the plane of the photograph from changes in color. Some countings were made concerning the behavior of low speed streaks as a function of y and the relation between streaks and some other structures. A new detection criterion for streaks is proposed. The distribution for the spanwise velocity of a streak was determined. It is shown that

the detection criteria of Blackwelder and Kaplan essentially samples spanwise passages of streaks. A few results of multiple color visualization are shown to establish unambiguously the vertical transport associated with streaks. Author

N88-23154*# Lehigh Univ., Bethlehem, Pa. Dept. of Mechanical Engineering and Mechanics.
STRUCTURE OF UNSTEADY FLOWS AT LEADING- AND TRAILING-EDGES: FLOW VISUALIZATION AND ITS INTERPRETATION
D. Rockwell, R. Atta, L. Kramer, R. Lawson, D. Lusseyran, C. Magness, D. Sohn, and T. Staubli *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 13 p Sponsored in part by NASA, NSF, Navy, AF, and Volkswagen Foundation (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01 CSCL 20D

Unsteady two- and three-dimensional flow structure at leading and trailing edges of bodies can be characterized effectively using recently developed techniques for acquisition and interpretation of flow visualization. The techniques addressed here include: flow image/surface pressure correlations; 3-D reconstruction of flow structure from flow images; and interactive interpretation of flow images with theoretical simulations. These techniques can be employed in conjunction with: visual correlation and ensemble-averaging, both within a given image and between images; recognition of patterns from images; and estimates of velocity eigenfunctions from images. Author

N88-23155# Hamburg Model Basin (West Germany).
MEASUREMENTS OF THE TIME DEPENDENT VELOCITY FIELD SURROUNDING A MODEL PROPELLER IN UNIFORM WATER FLOW
Joerg Blaurock and Gerd Lammers *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 13 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

As part of a research program, the flow field around an operating ship propeller was investigated in a water tunnel, using laser Doppler velocimetry. The 3-D velocity field was measured in three planes at the suction side and four planes on the pressure side of the propeller at the design thrust coefficient of K sub T = 0.185. In one of the planes in the propeller's slipstream, the measurements were repeated at thrust coefficients of K sub T = 0.12 and 0.25. The volocity profiles measured in the propeller's slipstream are compared with the induced velocities derived from design calculations, and occurring deviations are discussed. Furthermore, the instationary flow field permits study of the tip vortices at different distances behind the propeller. The measurements yield a quantitative description of the vortices, and the influence of propeller load at the blade tips on geometry and intensity of the tip vortices can be seen. Author

N88-23156# Admiralty Research Establishment, Gosport (England).
EXPERIMENTS TO INVESTIGATE THE VORTICES SHED FROM A SUBMARINE-LIKE BODY OF REVOLUTION
A. R. J. M. Lloyd and I. M. C. Campbell (Southampton Univ., England) *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 22 p Presented at the 59th Meeting of the AGARD Fluid Dynamics Panel Symposium, Monterey, Calif., 20-23 Oct. 1986 (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

Described are experiments to determine the characteristics of the vortices shed from a submarine-like body of revolution at an angle of attack in a turn. The experiments used a new type of vorticity probe developed by Freestone at the City University in the UK. The probe allows the streamwise vorticity to be estimated from simple pressure measurements and rapid assessments of vortex position and strength can be made. The paper examines the expected performance of the probe using a simulation of an ideal viscous cored vortex and reports experience gained in the design and preliminary testing of the probe. Results of experiments to measure the vortex shed by a hydroplane at an angle of attack and a body of revolution in a turn are reported. Author

N88-23157# Admiralty Research Establishment, Gosport (England). Submarine Hydrodynamics and Experiment Services Div.
A REVIEW OF THE NATO SPECIAL GROUP OF EXPERTS ON NAVAL HYDROMECHANICS AND RELATED PROBLEMS
John Charlesworth and L. John Leggat (Defence Research Establishment Atlantic, Dartmouth, Nova Scotia) *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 12 p (For primary document see N88-23125 16-34)
Avail: NTIS HC A20/MF A01

The Special Group of Experts on Naval Hydromechanics and Related Problems (SGE-HYDRO) was formed following an exploratory meeting on 3 to 4 November 1982. Its formation was spurred to a large degree by the need within NATO for a forum to promote multinational cooperation in the general area of Naval hydromechanics testing and research for problems not adequately covered by other NATO international exchange groups and the International Towing Tank Conference. The Group's mandate allows it to address current aspects of interest to Naval hydromechanics including test and research facilities, test techniques and instrumentation, prediction methods, model to full scale correlations, full scale trials, model tests, math modeling and simulation, and implications of instrumentation development in other fields. Author

N88-23158# California Inst. of Tech., Pasadena. Jet Propulsion Center.
GRAVITY CURRENTS WITH HEAT TRANSFER EFFECTS
M. V. Chobotov, E. E. Zukoski, and T. Kubota Mar. 1988 175 p
(Contract NBS-60-NANB6D-0638)
(PB88-180047; NBS/GCR-88/543) Avail: NTIS HC A08/MF A01 CSCL 20D

Experiments on gravity current flowing in horizontal channels are performed. First examined are adiabatic aqueous flows. Photography of dyed saline current fronts flowing into a fresh-water-filled duct allows for front velocity measurements and the study of qualitative flow featurs such as current head structure, mixing, and layer thickness. A model of gravity current entrainment is presented. The effects of viscosity are examined in the transition from constant velocity flow to a decelerating, viscous-dominated flow regime. The transition occurs at a streamwise position that is a function only of the current layer thickness. To examine effects on gravity currents of reduction of buoyant forces due to heat loss, heated gaseous flows are studied in a second facility. GRA

N88-23159# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ADVANCED CHEMICAL HEAT PUMPS USING LIQUID-VAPOR REACTIONS
L. Kirol 1987 8 p Presented at the 9th Annual Industrial Energy Technology Conference, College Station, Tex., 16 Sep. 1987
(Contract DE-AC07-76ID-01570)
(DE88-006760; EGG-M-16887; CONF-8709166-6) Avail: NTIS HC A02/MF A01

Chemical heat pumps utilizing liquid-vapor reactions can be configured in forms analogous to electric drive vapor-compression heat pumps and heat activated absorption heat pumps. Basic thermodynamic considerations eliminate some heat pumps and place restrictive working fluid requirements on others, but two thermodynamically feasible systems have significant potential advantage over conventional technology. An electric drive reactive heat pump can use smaller heat exchangers and compressor than a vapor-compression machine, and have more flexible operating characteristics. A waste heat driven heat pump (temperature amplifier) using liquid-vapor chemical reactions can operate with higher coefficient of performance and smaller heat exchangers

than an absorption temperature amplifying heat pump. Higher temperatures and larger temperature lifts should also be possible. DOE

N88-23160*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
NONLINEAR WAVE INTERACTIONS IN SWEPT WING FLOWS
Nabil M. ElHady May 1988 53 p
(Grant NAG1-729)
(NASA-CR-4142; NAS 1.26:4142) Avail: NTIS HC A04/MF A01 CSCL 20D

An analysis is presented which examines the modulation of different instability modes satisfying the triad resonance condition in time and space in a three-dimensional boundary layer flow. Detuning parameters are used for the wave numbers and the frequencies. The nonparallelism of the mean flow is taken into account in the analysis. At the leading-edge region of an infinite swept wing, different resonant triads are investigated that are comprised of travelling crossflow, vertical vorticity and Tollmein-Schlichting modes. The spatial evolution of the resonating triad components are studied. Author

N88-23161# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NUMBER 1987-3, 238/MAY-JUNE
ESA Nov. 1987 72 p
(ESA-TT-1075; ETN-88-91977) Avail: NTIS HC A04/MF A01

Validation of turbulence models applied to transonic shock-wave/boundary-layer interaction; effect of computation parameters on the results of 3-D potential methods; infrared signature of flames: spectral data of carbon dioxide at high temperature; time stability of schemes using high order spatial discretization in the case of a convection equation; and flow around a symmetrical profile (hydrodynamic visualizations) are discussed. ESA

N88-23162# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
NUMERICAL TREATMENT OF NAVIER-STOKES EQUATIONS [NUMERIEKE BEHANDELING VAN DE NAVIER-STOKES VERGELIJKINGEN]
A. E. P. Veldman, ed., J. J. P. vanHutzen, J. J. I. M. vanKan, J. Th. vanderKolk, B. vanLeer, H. Schippers (National Aerospace Lab., Amsterdam, Netherlands), and A. Segal 1987 229 p In DUTCH
(Rept-87-22; B8713791; ISSN-0920-2358; ETN-88-91342)
Copyright Avail: NTIS HC A11/MF A01

Numerical algorithms to solve the Navier-Stokes equations, and the implementation of the algorithms in programming systems for flow simulation are discussed. The fundamentals of the modeling and discretization of the Navier-Stokes equations are presented. The spatial discretization methods to solve partial differential equations are outlined. The calculation of time-dependent and steady-state solutions of the Euler equations is discussed. Methods to solve incompressible flows are introduced. The development of user programming systems for the numerical treatment of flows is reviewed. The pre- and postprocessing activities for numerical flow simulation are described. ESA

N88-23163# Institut de Mecanique des Fluides de Marseille (France).
STUDY OF THE BOUNDARY LAYER OF A FLOW PULSED BY ACOUSTIC WAVES Final Report [COUCHE LIMITE EN ECOULEMENT PULSE PAR ONDES ACOUSTIQUES]
E. Brocher, V. Pugliesi, and E. Duport 1987 46 p In FRENCH
(Contract DRET-82-490)
(ETN-88-91998) Avail: NTIS HC A03/MF A01

A wind tunnel study was carried out subjecting a flat plate to strong pressure pulses obtained with a resonator. The subsonic flow is incompressible and uniform. The means used to visualize the flow and the separation criteria are discussed. The main result is the operational verification of the experimental design. The measurement shows fluctuations six times stronger inside the boundary than outside. ESA

N88-23164# Karlsruhe Univ. (West Germany). Sonderforschungsbereich 210.
APPLICATION OF A MULTIGRID METHOD FOR SOLVING THE NAVIER-STOKES EQUATION IN TWO-DIMENSIONAL FLOW PROBLEMS
A. O. Demuren Oct. 1986 37 p Sponsored by the Deutsche Forschungsgemeinschaft, Bonn, Fed. Republic of Germany
(KU-SFB-210/T/32; ETN-88-92117) Avail: NTIS HC A03/MF A01

A multigrid method was applied to the solution of the Navier-Stokes equation for two-dimensional laminar flow problems. The performance of the multigrid method, using two different (point and line) relaxation schemes is compared to those of single-grid schemes. The better multigrid method always converges much faster than the best single-grid method. The finer the grid, the more favorable is the comparison of the rate of convergence. The importance of the choice of the relaxation scheme for the multigrid method is illustrated. ESA

N88-23165# Karlsruhe Univ. (West Germany).
ON THE USE OF NONSTAGGERED PRESSURE-VELOCITY ARRANGEMENT FOR THE NUMERICAL SOLUTION OF INCOMPRESSIBLE FLOWS
S. Majumdar, W. Rodi, and S. P. Vanka Nov. 1987 24 p Sponsored by the Deutsche Forschungsgemeinschaft, Bonn, Fed. Republic of Germany and the Wright-Patterson AFB, Ohio
(KU-SFB-210/T/35; ETN-88-92344) Avail: NTIS HC A03/MF A01

An equivalence between the classical staggered-mesh procedure and the nonstaggered mesh procedure for solution of incompressible flows is demonstrated. The similarities between the mathematical basis of both the procedures are shown. With the help of numerical examples, it is demonstrated that for incompressible flows, the success of a numerical solution procedure depends on how the continuity satisfying velocities on the faces of the control volume are calculated. The calculation of the velocities at the center of the control volume in the nonstaggered mesh procedure is shown to be redundant. ESA

N88-23166# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
EFFECTS OF RANDOMNESS OF PARAMETERS ON MEAN WAVE PROPAGATION IN A VISCOELASTIC MEDIUM
Z. Hryniewicz and A. J. Hermans 1987 21 p
(Rept-87-60; B8733840; ISSN-0920-8577; ETN-88-92436)
Copyright Avail: NTIS HC A03/MF A01

The effect of the randomness of material parameters on mean wave propagation in a randomly nonhomogeneous layer overlying a homogeneous half-space and loaded harmonically on the top surface is studied. The method used is that of Karal and Keller (1964) and is based on the idea of fundamental matrix and Bourret approximation. The integrodifferential equation obtained is solved by Laplace transform method. By using boundary and continuity conditions the mean-wave solution is obtained. Numerical results show that the correlation functions, which introduce long-range interactions, can be the source of wave amplification. ESA

N88-23167# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
SOME NUMERICAL METHODS FOR THE COMPUTATION OF CAPILLARY FREE BOUNDARIES GOVERNED BY THE NAVIER-STOKES EQUATIONS
C. Cuvelier 1987 112 p Presented at the Dutch Mathematical Congress, Utrecht, The Netherlands, Apr. 1987
(Rept-87-69; B8735225; ISSN-0920-8577; ETN-88-92445)
Copyright Avail: NTIS HC A06/MF A01

The trial method, Newton's method, and the total linearization method are applied to a simple 1D free boundary (FB) problem

for which the solution is known, emphasizing convergence speed and computer implementation facilities of these methods. Static FB problems in 2D and 3D containers governed by the Laplace-Young equation are studied. Two stationary FB problems governed by the Navier-Stokes equations are solved using the three methods. A thermocapillary FB problem in crystal growth, governed by the Navier-Stokes equations coupled with the heat equation, is analyzed. A moving FB problem governed by the Navier-Stokes equations is considered within the context of perturbation theory. Research in frequency-analysis of fluid-structure systems is discussed. ESA

N88-23168# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
A SMALL CONCENTRATION EXPANSION FOR THE EFFECTIVE HEAT CONDUCTIVITY OF A RANDOM DISPERSE TWO-COMPONENT MATERIAL; AN ASSESSMENT OF BATCHELOR'S RENORMALIZATION METHOD
P. vanBeek 1987 14 p
(Rept-87-71; B8735227; ISSN-0920-8577; ETN-88-92447)
Copyright Avail: NTIS HC A03/MF A01

The difficulty in the expansion of the effective properties of random disperse media in powers of the volume concentration c of the disperse phase presented by the divergence of certain integrals that perform averaging of two-particle approximations is considered. The random heat conduction problem analyzed by Jeffrey (1974) is treated using Batchelor's (1974) renormalization method. Batchelor's two-particle equation is extended to a hierarchical set of n-particle equations for arbitrary n. The solution of the hierarchy is seen to consist of a sequence of two, three, and more particle terms. The two and three-particle terms are calculated. It is proved that all i-particle terms (i greater than or = 2) can be averaged convergently showing that the hierarchical approach yields a well-defined expansion in integer powers of c of the effective conductivity. It follows that Jeffrey's expression for the effective conductivity is 0(c sq) - accurate. ESA

N88-23169# European Space Agency, Paris (France).
COMPARISON OF DIFFERENT KINDS OF COMPACT CROSSFLOW HEAT EXCHANGERS
Werner Siemens (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne, West Germany) Mar. 1988 80 p Transl. into ENGLISH of Vergleichende Rechnungen an Kompakten Platten- und Profil-Waermetauschern (Cologne, Fed. REpublic of Germany, DFVLR), Sep. 1986 82 p Original language document was announced as N88-10305
(ESA-TT-1076; DFVLR-FB-86-63; ETN-88-92558) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 29.50 DM

A computer program for the calculation of compact heat exchangers for gas turbines was developed. The most important coefficients, pressure drops, and effectiveness of different kinds of exchangers were calculated as a function of Mach number, the dimensions of the exchanger, and the compactness. From the aerothermodynamic point of view, the plate exchanger is best, closely followed by the lancet heat exchanger. The ribs of the plate version have no significant effect on the characteristics, but are required for stiffness and uniform channel height. The tube heat exchanger can only compete as far as the transferable heat is concerned. ESA

N88-23170# European Space Agency, Paris (France).
THEORETICAL INVESTIGATIONS OF THREE TURBINE CASCADES USING A 2-D TIME MARCHING PROCEDURE
Peter-Anton Giess (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany) Mar. 1988 80 p Transl. into ENGLISH of Theoretische Untersuchungen mit Hilfe eines 2-D-Zeitschrittverfahrens an drei Turbinengittern (Goettingen, Fed. Republic of Germany, DFVLR), Dec. 1986 78 p Original language document was announced as N88-10362
(ESA-TT-1077; DFVLR-FB-87-02; ETN-88-92559) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 23 DM

Flow field calculations in the subsonic and transonic downstream velocity range were performed for a stator and two rotor cascades using a two-dimensional time marching procedure. The convergence behavior of the numerical solution was determined by the time evolution of the homogeneous flow quantities. The evaluation of the local flow quantities allowed the verification of the assumptions on which the simplified methods for the calculation of the homogeneous downstream flow angle are based. The agreement between calculated results and experimental data becomes better when the real experimental conditions are better modelled in the calculation. ESA

N88-23171*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
EXPERIMENTAL STUDIES OF VORTEX FLOWS Final Report, Mar. 1984 - May 1988
L. Roberts and R. Mehta Jun. 1988 8 p
(Contract NCC2-294)
(NASA-CR-182874; NAS 1.26:182874) Avail: NTIS HC A02/MF A01 CSCL 20D

This final report describes research work on vortex flows done during a four-year period beginning in March 1984 and funded by NASA Grant NCC2-294 from the Fluid Dynamics Research Branch of NASA Ames Research Center. After a brief introduction of the main topics addressed by the completed research, the accomplishments are summarized in chronological order. Author

N88-23172*# National Aeronautics and Space Administration, Washington, D.C.
THE THEORY OF FLOTATION
Wolfgang Ostwald May 1988 13 p Transl. into ENGLISH from Z. Physikal. Chem. (Fed. Republic of Germany), v. 173, no. 6 p 393-400 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20278; NAS 1.77:20278) Avail: NTIS HC A03/MF A01 CSCL 20D

A brief summary of the fundamentals of the Linear theory of flotation is given. The theory by no means contradicts the previous Laminar theory or even the thermodynamics (Wark-Siedler), rather it is a refinement of the known Hardy-Langmuir-Harkin conceptions for the case when there are not two phases and phase boundaries, but rather three phases and corresponding phase boundary edges. The appearance of such three-phase boundaries (ore, water, air) is characteristic for modern flotation methods. Author

N88-23173*# National Aeronautics and Space Administration, Washington, D.C.
DEFLECTION OF A CIRCULAR LIQUID JET ON A FLAT PLATE PERPENDICULAR TO THE FLOW DIRECTION
W. Schach May 1988 16 p Transl. into ENGLISH from Ing. Arch. (Fed. Republic of Germany), v. 6, 1935 p 51-59 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20279; NAS 1.77:20279) Avail: NTIS HC A03/MF A01 CSCL 20D

The deflection of a flat water jet on a flat plate perpendicular and oblique to the flow direction can be determined with the Prandtl hodograph method. The outer jet shape of the circular water jet for perpendicular impact on a flat plate was measured in tests by Reich and was represented by an empirical equation. The problem can also be discussed mathematically, if the flow to be axisymmetric potential flow is to be considered. For this purpose, the same method which Trefftz established for calculating the contraction of a circular liquid jet can be used. Author

N88-23174*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ON THE PREDICTION OF EQUILIBRIUM STATES IN HOMOGENEOUS TURBULENCE Final Report

Charles G. Speziale and Nessan MacGiolla Mhuiris Apr. 1988 47 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181659; ICASE-88-27; NAS 1.26:181659) Avail: NTIS HC A03/MF A01 CSCL 20D

A comparison of several commonly used turbulence models (including the Kappa-epsilon and two second-order closures) is made for the test problem of homogeneous turbulent shear flow in a rotating frame. The time evolution of the turbulent kinetic energy and dissipation rate is calculated for a variety of models and comparisons are made with previously published experiments and numerical simulations. Particular emphasis is placed on examining the ability of each model to accurately predict equilibruim states for a range of the parameter Omega/S (the ratio of the rotation rate to the shear rate). It is found that none of the commonly used second-order closure models yield substantially improved predictions for the time evolution of the turbulent kinetic energy and dissipation rate over the somewhat defective results obtained from the simpler Kappa-epsilon model for the turbulent flow regime. There is also a problem with the equilibrium states predicted by the various models. For example, the Kappa-epsilon model erroneously yields equilibrium states that are independent of Omega/S while the Launder, Reece, and Rodi model predicts a flow relaminarization when Omega/S is greater than 0.39 - a result which is contrary to numerical simulations and linear spectral analysis which indicate flow instability for at least the range 0 less than or = Omega/S less than or = 0.5. The physical implications of the results obtained from the various turbulence models considered here are discussed in detail along with proposals to remedy the deficiencies based on a dynamical systems approach. Author

N88-23175# Institute for Scientific Computing, Fort Collins, Colo.
FAST ALGORITHMS FOR EULER AND NAVIER-STOKES SIMULATIONS Final Report, 1 Jan. - 30 Sep. 1987
G. M. Johnson 30 Nov. 1987 15 p
(Grant AF-AFOSR-0133-87)
(AD-A190897; AFOSR-87-1983TR) Avail: NTIS HC A03/MF A01 CSCL 20D

An explicit flow solver, applicable to the hierarchy of model equations ranging from Euler to full Navier-Stokes, was combined with several techniques designed to reduce computational expense. The computational domain consisted of local grid refinements embedded in a global coarse mesh, where the locations of these refinements are defined by the physics of the flow. Flow characteristics were also used to determine which set of model equations is appropriate for solution in each region, thereby reducing not only the number of grid points at which the solution must be obtained, but also the computational effort required to get that solution. Acceleration to steady-state was achieved by applying multigrid on each of the subgrids, regardless of the particular model equations being solved. Since each of these components is explicit, advantage could readily be taken of the vector-and parallel-processing capabilities of machines such as the Cray X-MP and Cray 2. GRA

N88-23176# Naval Research Lab., Washington, D.C.
SOLUTION OF THE COMPRESSIBLE NAVIER-STOKES EQUATIONS OF MOTION BY CHEBYSHEV POLYNOMIALS FOR LAMINAR SHOCK-BOUNDARY LAYER FLOW
Leonidas Sakell 18 Mar. 1988 23 p
(AD-A191033; NRL-MR-6152) Avail: NTIS HC A03/MF A01 CSCL 20D

This time dependent, compressible, 2-D Navier-Stokes equations of motion are solved by full pseudo spectral means. The flow solved for is a laminar oblique shock-boundary layer interaction. Comparison of the numerical surface pressure field with the experimental one is very good. GRA

N88-23177# Iowa State Univ. of Science and Technology, Ames.
USER'S MANUAL FOR EULER3DS Final Report, Oct. 1986 - Sep. 1987
R. G. Hindman Jan. 1988 33 p Prepared in cooperation with AEDC, Arnold AFS, Tenn.
(AD-A191048; AEDC-TR-87-36) Avail: NTIS HC A03/MF A01 CSCL 20D

EULAR3DS is a robust three dimensional space marching code for computing steady state solutions to the Euler equations applied to external flows. The code solves the integral equations of motion in a finite volume sense and is thus totally conservative. The algorithm used is called the ALPHA-scheme and was developed by the author for this code. This scheme is explicit with either first or second order accuracy and is constructed by splitting the fluxes on cell faces to account for upwind signal propagation. The code solves the governing equations using either a perfect gas model or an equilibrium air gas model. There are six options regarding the grid generation schemes employed and the code is fully compatible with QUICK geometry modelling system. The purpose of this document is to describe the code in a manner that will familiarize the user with the code's options and structure and enable relatively painless usage of the code. GRA

N88-23178# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
PRELIMINARY MEASUREMENTS OF HEAT FLUX IN A SUBSONIC GUN SIMULATOR Interim Report No. 1
A. F. Bicen, M. Schmidt, and J. H. Whitelaw Dec. 1987 17 p
(Contract DAJA45-87-C-0045)
(AD-A191090) Avail: NTIS HC A03/MF A01 CSCL 20L

Preliminary measurements of heat flux have been obtained in a subsonic gun simulator with thin film resistance thermometry for an inert, single phase flow expanding behind a projectile from an initial pressure of 8 bars and resulting in an exit projectile velocity of 40 m/s. The results show that heat transfer measurements at locations swept by the projectile are possible using thin-film sensors set into the wall by 0.1 mm and that the heat flux at various axial locations decreases with time and increases with distance from the breech, The measured convection coefficients at locations swept by the projectile differ up to 50 percent from those evaluated with quasi-steady flow assumption from a correlation for turbulent boundary layer with zero pressure gradient starting at the breech, due to the neglect of pressure gradient as well as to the effect of projectile wake on the boundary layer development. GRA

N88-23179# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
NONCONDENSING ROUND TURBULENT GAS JETS IN LIQUIDS Interim Report, 1 Aug. 1985 - 30 Sep. 1987
E. Loth and G. M. Faeth Oct. 1987 69 p
(Contract N00014-85-K-0604)
(AD-A191191) Avail: NTIS HC A04/MF A01 CSCL 20D

The structure and mixing properties of noncondensing round turbulent air jets in still water was investigated experimentally, considering both subsonic and sonic underexpanded (with underexpanded ratios up to 8:1) jet exit conditions. Measurements included flow visualization, using flash and high-speed motion-picture photography; mean void fraction distributions, using deconvoluted gamma-ray absorption measurements; mean entrainment velocities, using laser-Doppler anemometry; and mean static pressures along the axis, using a static pressure probe. Analysis was also undertaken to help interpret the measurements, based on the locally-homogeneous-flow approximation (relative velocity differences between the phases neglected) and an effective-adapted-jet approximation for treating the mixing properties of the underexpanded jets. GRA

N88-23180# Stanford Univ., Calif. Dept. of Mechanical Engineering.
SIMULATION OF LAMINAR-TURBULENT TRANSITION IN THE VICINITY OF A WALL Final Report, Feb. - Oct. 1987
Joel H. Ferziger and Helen L. Reed 7 Jan. 1988 7 p

(Grant AF-AFOSR-0083-84)
(AD-A191380; AFOSR-88-0027TR) Avail: NTIS HC A02/MF A01 CSCL 20D

Numerical simulation was used to explore the process of transition that a flow undergoes in changing from a laminar state to a turbulent state. The effort concentrated on three relatively simple flows for which extensive databases exist; these are the plane channel, curved channel, and flat boundary layer flows. Significant results were produced for all three cases. GRA

N88-23181# Ballistic Research Labs., Aberdeen Proving Ground, Md.
RANDOM PROCESSES, TURBULENCE AND DISORDERING FIELDS
G. Domokos, S. Kovesi-Domokos, and C. K. Zoltani Oct. 1987 28 p
(AD-A191399; BRL-TR-2861) Avail: NTIS HC A03/MF A01 CSCL 20D

The statistical theory of random processes is cast into a Lagrangian form. The formalism requires the existence of an arbitrarily weak random stirring force, playing the role of a disordering field. In scale invariant systems the coupling strength of the weak stirring force can be scaled out and it disappears from the theory. The formalism is applied to the turbulent flow of an incompressible fluid; in particular, we derive the Feynman rules by means of which the distribution of fluctuations around an average flow can be determined. As an illustration, we discuss a stationary flow between two parallel planes. An expansion in inverse powers of the Reynolds number (analogous to a semiclassical expansion in Quantum Field Theory) is outlined. In particular, we compute the vorticity correlation function to leading order in inverse powers of the Reynolds number. GRA

N88-23182*# Grumman Aerospace Corp., Bethpage, N.Y.
SOLAR DYNAMIC HEAT REJECTION TECHNOLOGY. TASK 2: HEAT PIPE RADIATOR DEVELOPMENT Final Report
Mark League and Joe Alario May 1988 46 p
(Contract NAS3-24665)
(NASA-CR-182141; NAS 1.26:182141) Avail: NTIS HC A03/MF A01 CSCL 20D

This report covers the design, fabrication, and test of several dual slot heat pipe engineering development units. The following dual-slot heat pipes were fabricated and tested: two 6-ft. aluminum heat pipes; a 20-ft. aluminum heat pipe; and a 20-ft. aluminum heat pipe with a four-leg evaporator section. The test results of all four test articles are presented and compared to the performance predicted by the design software. Test results from the four-leg article are incomplete. The methodology for fabricating stainless steel dual slot heat pipes was also studied by performing a tool life test with different single point cutters, and these results are also presented. Although the dual-slot heat pipe has demonstrated the potential to meet the requirements for a high capacity radiator system, uncertainties with the design still exist. The startup difficulties with the aluminum test articles must be solved, and a stainless steel/methanol heat pipe should be built and tested. Author

N88-23183# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
INVESTIGATION OF SUBGRID MODELS IN HOMOGENEOUS INCOMPRESSIBLE TURBULENCE Final Report [ETUDE DE MODELES DE SOUS-MAILLE EN TURBULENCE HOMOGENE INCOMPRESSIBLE]
C. Teissedre Aug. 1987 29 p In FRENCH
(Contract DRET-87-34-00)
(ONERA-RSF-13/3419-AY-106-A; ETN-88-92297) Avail: NTIS HC A03/MF A01

A data base of simulated homogeneous, incompressible turbulence in an anisotropic regime was derived using a direct simulation code on a parallel processing computer. The simulated distributions were used to validate subgrid models of the turbulent viscosity and similitude type (analogy between the near field of the cut-off and the subgrid field). The first type of model accounts for the evolution of turbulent kinetic energy well, while the second type, although it better represents the exact value of stress in the subgrid, seems to present a defect of nondissipation. Tests of a model of perturbation of nonlinear terms were performed in an isotropic situation with large structures. The results show the same kind of nondissipative behavior as for the similitude model. ESA

N88-23184*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INITIAL CONDITION EFFECT ON PRESSURE WAVES IN AN AXISYMMETRIC JET
Jeffrey H. Miles and Ganesh Raman (Sverdrup Technology, Inc., Cleveland, Ohio.) 1988 14 p Proposed for presentation at the 1st National Fluid Dynamics Congress, Cincinnati, Ohio, 24-28 Jul. 1988; sponsored by AIAA, ASME, ASCE, SIAM and APS
(NASA-TM-100915; E-4076; NAS 1.15:100915) Avail: NTIS HC A03/MF A01 CSCL 20D

A pair of microphones (separated axially by 5.08 cm and laterally by 1.3 cm) are placed on either side of the jet centerline to investigate coherent pressure fluctuations in an axisymmetric jet at Strouhal numbers less than unity. Auto-spectra, transfer-function, and coherence measurements are made for a tripped and untripped boundary layer initial condition. It was found that coherent acoustic pressure waves originating in the upstream plenum chamber propagate a greater distance downstream for the tripped initial condition than for the untripped initial condition. In addition, for the untripped initial condition the development of the coherent hydrodynamic pressure waves shifts downstream. Author

N88-23185*# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
TWO-EQUATION LOW-REYNOLDS-NUMBER TURBULENCE MODELING OF TRANSITIONAL BOUNDARY LAYER FLOWS CHARACTERISTIC OF GAS TURBINE BLADES Ph.D. Thesis. Final Contractor Report
Rodney C. Schmidt and Suhas V. Patankar May 1988 273 p
(Grant NAG3-579)
(NASA-CR-4145; E-3960; NAS 1.26:4145) Avail: NTIS HC A12/MF A01 CSCL 20D

The use of low Reynolds number (LRN) forms of the k-epsilon turbulence model in predicting transitional boundary layer flow characteristic of gas turbine blades is developed. The research presented consists of: (1) an evaluation of two existing models; (2) the development of a modification to current LRN models; and (3) the extensive testing of the proposed model against experimental data. The prediction characteristics and capabilities of the Jones-Launder (1972) and Lam-Bremhorst (1981) LRN k-epsilon models are evaluated with respect to the prediction of transition on flat plates. Next, the mechanism by which the models simulate transition is considered and the need for additional constraints is discussed. Finally, the transition predictions of a new model are compared with a wide range of different experiments, including transitional flows with free-stream turbulence under conditions of flat plate constant velocity, flat plate constant acceleration, flat plate but strongly variable acceleration, and flow around turbine blade test cascades. In general, calculational procedure yields good agreement with most of the experiments. Author

N88-23186*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF BYPASS TRANSITION IN A BOUNDARY LAYER M.S. Thesis
Kenneth L. Suder, James E. OBrien, and Eli Reshotko (Case Western Reserve Univ., Cleveland, Ohio.) May 1988 199 p
(NASA-TM-100913; E-3953; NAS 1.15:100913) Avail: NTIS HC A09/MF A01 CSCL 20D

A detailed investigation to compare the boundary layer transition process in a low intensity disturbance environment to that in an environment in which the disturbances are initially non-linear in amplitude was conducted using a flat plate model. The transition mechanism based on linear growth of Tollmien Schlichting (T-S) waves was associated with a freestream turbulence level of 0.3

percent; however, for a freestream turbulence intensity of 0.65 percent and higher, the bypass transition mechanism prevailed. The results of detailed measurements acquired to study and compare the two transition mechanisms indicate that there exists a critical value for the peak rms of the velocity fluctuations within the boundary layer of approximately 3 to 3.5 percent of the freestream velocity. Once the unsteadiness within the boundary layer reached this critical value, turbulent bursting initiated, regardless of the transition mechanism. The two point correlations and simultaneous time traces within the transition region illustrate the features of a turbulent burst and its effect on the surrounding flowfield. Author

N88-23187*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LASER DOPPLER ANEMOMETRY
Dennis A. Johnson Jun. 1988 13 p
(NASA-TM-100072; A-88101; NAS 1.15:100072) Avail: NTIS HC A03/MF A01 CSCL 20D

The material in this NASA TM is to appear as a chapter on Laser Doppler Anemometry (LDA) in the AGARDograph entitled, A Survey of Measurements and Measuring Techniques in Rapidly Distorted Compressible Turbulent Boundary Layers. The application of LDA (specifically, the dual-beam, burst-counter approach) to compressible flows is discussed. Subjects treated include signal processing, particle light scattering and tracking, data reduction and sampling bias, and three-dimensional measurements. Author

N88-23037# Joint Publications Research Service, Arlington, Va.
NUMERICAL ANALYSIS OF CRITICAL PENETRATION VELOCITY FOR JET PERPENDICULAR PENETRATION
Mengzhao Qin, Chunsheng Xie, Qingming Tan, and Xiaoping Liu *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 8-20 Transl. into ENGLISH from Lixue Xuebao (Beijing, People's Republic of China), v. 19, no. 2, Mar. 1987 p 101-110 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N88-23188# Sandia National Labs., Albuquerque, N. Mex.
A COMPACT HIGH RESOLUTION PIEZORESISTIVE DIGITAL TACTILE SENSOR
B. Tise 1987 11 p Presented at the IEEE International Conference on Robotics and Automation, Philadelphia, Pa., 25 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE88-000430; SAND-87-2224C; CONF-880424-5) Avail: NTIS HC A03/MF A01

A tactile sensor has been developed which provides a 256 element tactile image to a host computer. The sensor contains all required circuitry to scan the sensor array and provide eight-bit digitized data as well as synchronization signals. The sensing area is 0.5 in. x 0.5 in., providing spatial resolution of 0.031 in. The overall package measures 0.8 in. x 0.8 in. x 0.25 in., making it small enough to be located on a fingertip. The circuitry is located inside the package on a hybrid microcircuit which measures 0.5 in. x 0.5 in. The sensing elements are force sensing resistors with a wide usable force range. DOE

N88-23189# Technische Hogeschool, Delft (Netherlands).
THE SILICON MICROSTRIP DETECTOR Ph.D. Thesis
Warner Rudolph Theop tenKate 1987 148 p
(ETN-88-92235) Avail: NTIS HC A07/MF A01

Fabrication, operation, and readout of silicon microstrip detectors for high energy physics experiments are discussed. The influence of fabrication on leakage current is stressed. Pulse response on detector strips and the influence of strip width are examined. Active, passive, and charge coupled device readout schemes are described. ESA

N88-23190# Technische Hogeschool, Delft (Netherlands).
THERMAL VACUUM SENSORS BASED ON INTEGRATED SILICON THERMOPILES Ph.D. Thesis
Alexander Willem vanHerwaarden 1987 174 p
(ETN-88-92237) Avail: NTIS HC A08/MF A01

The operating principle of thermal vacuum sensors was studied, and models of the structures feasible with integrated-circuits technology were constructed. The feasibility of thermal vacuum sensors based on integrated silicon thermopiles is shown. Sensors optimized with the results of theoretical models were designed. The theoretical models of the sensors were verified, and experimental results to improve the theoretical models were obtained. The performance of the sensors as a vacuum gage was assessed. Optimal structures were compared with thermal vacuum gages. ESA

N88-23191# Technische Hogeschool, Eindhoven (Netherlands).
THE DEVELOPMENT OF A MICROANEMOMETER. NEW POSSIBILITIES FOR MEASURING VERY LOW AIR VELOCITIES Ph.D. Thesis
Martinus Johannes Fr Pluijm 1987 130 p
(ETN-88-92244) Avail: NTIS HC A07/MF A01

A microanemometer based on the principle of the measurement of the (moment of) force exerted on the pointer of a moving-coil meter by the air flow is described. By sending a current through the coil the Lorentz couple serves as retroactive couple. In the case of equilibrium, the feedback current is a measure of the air velocity. For calibration of the microanemometers in practice and establishment of the lowest detection limit, a calibration unit capable of producing air velocities from 1 mm/sec to 15 cm/sec is presented. The influence of the microanemometer in the calibration unit on the air velocities in the vicinity of the microanemometer was calculated. Calibration of the microanemometers results in a lowest detectable air velocity of 1 mm/sec. Air velocities are measurable up to a few m/sec. The simultaneous measurement of several velocity components using a number of moving-coil meters with their pointers in different directions is described. The applicability of the microanemometers was tested in fume hoods and in operating theaters. ESA

N88-23192# Centre Nationale de la Recherche Scientifique, Palaiseau (France).
SURFACE WAVE ACCELEROMETER Final Report [ACCELEROMETRE A ONDES DE SURFACE]
J. J. Gagnepain and D. Hauden 1986 56 p In FRENCH
(Contract DRET-84-091)
(ETN-88-92000) Avail: NTIS HC A04/MF A01

A unidirectional one axis delay line accelerometer is presented. It is based on surface wave resonators implemented in an oscillator loop. The varying frequency is the device output. An AT-38 quartz crystal cross section working at 104 or 189 MHz is used. The temperature stabilization is of the order of 0.0016. The feasibility is demonstrated. The main axis sensitivity is of the order of 1000 Hz/g. The transversal sensitivity is 200 times less. ESA

N88-23193# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
AN INVESTIGATION INTO THE PRECISION OF A DIGITAL CAMERA M.S. Thesis
George Vosselman Nov. 1986 102 p Sponsored in part by the Netherlands Royal Institute of Engineers
(B8735054; ETN-88-92428) Avail: NTIS HC A06/MF A01

The point positioning precision of a CCD camera and a least squares matching technique was assessed using bundle block adjustment tests. A precision of 0.03 pixels (= 0.8 microns for a pixel size of 27 microns) is obtained for large symbols. The precision

of small symbols is 0.04 pixel (1.1 micron). The only significant camera deformation is a difference in x- and y-scale, caused by the different pixel sizes in column and row direction of the sensor array. The principal distance of the camera is 57.54 mm. The principal point could not be determined. After the adjustments, the residuals of the image coordinates of several images were plotted. Although they seemed to be random at the first sight, the residual patterns of certain images show large similarities. These correspondencies are not caused by possible differences in the distances between the individual sensors of the camera and are independent of the method of coordinate calculation, since the same phenomenon is observed after the adjustment of the coordinates of the symbols in the binary images. The precision of these centers of gravity in binary images is good: 0.04 pixel for large symbols and 0.05 pixel (1.4 micron) for small symbols.

ESA

N88-23194*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF MASS-VELOCITY ON LIQUID JET ATOMIZATION IN MACH 1 GASFLOW

Robert D. Ingebo 1988 8 p Proposed for presentation at the 4th International Conference on Liquid Atomization and Spray Systems, Sendai, Japan, 22-24 Aug. 1988; sponsored by the Fuel Society of Japan

(NASA-TM-100813; E-3944-1; NAS 1.15:100813) Avail: NTIS HC A02/MF A01 CSCL 14B

Interacting two-phase flow in four differently sized pneumatic two-fluid atomizers was investigated to determine the effect of gas mass-velocity on the Sauter mean diameter of sprays produced by small diameter liquid jets breaking up in high velocity gas flow. Tests were conducted primarily in the acceleration-wave regime for liquid jet atomization, where it was found that the loss of droplets due to vaporization had a marked effect on drop size measurements. A scattered-light scanner, developed at NASA Lewis Research Center, was used to measure the Sauter mean diameter, D sub 32, which was correlated with nitrogen gas mass-velocity to give the following expression: D (sup -1)(sub 32) = 11.7(rho (sub n) V (sub n)) (sup 1.33). The exponent 1.33 for the gas mass-velocity is identical to that predicted by atomization theory for liquid jet breakup in the acceleration-wave regime.

Author

N88-23195# Honeywell Electro-Optics Center, Lexington, Mass.

HYBRID PV HgCdTe IR DETECTORS TECHNOLOGY RELIABILITY AND FAILURE PROGRAM: ENVIRONMENTAL STRESS TESTING PLAN

27 Mar. 1987 8 p

(Contract N00014-86-C-2554)

(AD-A191165) Avail: NTIS HC A02/MF A01 CSCL 17E

Failure mechanisms are identified in hybridized (indium bump interconnected) HgCdTe/Si focal plane arrays created by hybridization and environmental stress. Hybridization and environmental stresses mentioned in the statement of work to be addressed are: (1) Repetitive temperature cycling between 300K and 80K; (2) Dewar bakeout; (3) Dormant storage for several weeks at 130F; (4) Long term storage (Honeywell believes the contract is not long enough to address long term storage); and (5) Hybridization force (dislocation density versus RoA). In plan both test arrays and focal planes will be stressed and characterized. Focal planes will be used to evaluate imaging performance while test arrays (interconnected to Si leadout boards) will be used to analyze changes in device performance by allowing the current voltage characteristics of individual photodiodes to be analyzed. After a test array has received a series of stresses, elements will be analyzed to identify the mechanism of failure. For example, if a test array has a large loss of interconnect it might be destructively pulled apart and analyzed using an SEM to determine where the loss of interconnect is occurring.

GRA

N88-23196*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DEVELOPMENT AND APPLICATIONS OF OPTICAL INTERFEROMETRIC MICROMETROLOGY IN THE ANGSTROM AND SUBANGSTROM RANGE

James L. Lauer (Rensselaer Polytechnic Inst., Troy, N.Y.) and Phillip B. Abel 1988 22 p Presented at the 34th International Instrumentation Symposium, Albuquerque, N. Mex., 2-5 May 1988; sponsored by the Instrument Society of America

(NASA-TM-100299; E-3945; NAS 1.15:100299) Avail: NTIS HC A03/MF A01 CSCL 14B

The recent development of the scanning electron tunneling microscope and the atomic force microscope requires absolute standards for measurements in the angstrom and subangstrom range. Optical interferometry with lasers and multiple mode laser resonances can provide absolute measurements as the laser wavelengths are very accurately known. A key feature of such measurements is the use of piezoelectric crystals as translators of the highest accuracy for very small disturbances. However, the dimensional changes of these crystals resulting from electrical potential changes depend on many variables, among them the method of mounting, so that accurate calibrations are necessary. Starting from advances in optical metrology made by physicists trying to find gravity waves, advances which led to measurements down to 10 to the -5 A, the author designed and built a much simpler system for the angstrom range. The major limiting factors were mechanical vibrations, air currents, thermal changes and laser instabilities.

Author

N88-23020# Joint Publications Research Service, Arlington, Va.

FRENCH EVALUATION OF JAPANESE BIOSENSORS

Silvia Vaisman *In its* JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 9-15 Transl. into ENGLISH from Biofutur (Paris, France) Feb. 1987 p 64-65, 67 (For primary document see N88-23018 16-31)

Avail: NTIS HC A05/MF A01

N88-23145# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mechanical and Aerospace Engineering and Chemical Engineering.

MATCHED INDEX LASER ANEMOMETRY SYSTEMS FOR FLOW STUDIES IN COMPLEX GEOMETRIES

A. Dybbs, R. V. Edwards, and E. Reshotko *In* AGARD, Aerodynamic and Related Hydrodynamic Studies Using Water Facilities Jun. 1987 18 p Sponsored in part by Case Center for Complex Flow Measurements, C3FM (For primary document see N88-23125 16-34)

(Contract N00014-84-K-0294; Grant NSF CME-79-13389)

Avail: NTIS HC A20/MF A01

N88-23229*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.

PIEZOELECTRIC PUSHERS FOR ACTIVE VIBRATION CONTROL OF ROTATING MACHINERY

Alan B. Palazzolo (Texas A&M Univ., College Station.) and Albert F. Kascak *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 29-46 (For primary document see N88-23226 16-39)

Avail: NTIS HC A20/MF A01 CSCL 14B

N88-23240*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.

LOW-COST OPTICAL DATA ACQUISITION SYSTEM FOR BLADE VIBRATION MEASUREMENT

Stephen J. Posta *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 191-202 Previously announced as N87-14730 (For primary document see N88-23226 16-39)

Avail: NTIS HC A20/MF A01 CSCL 14B

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N88-23197*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPARISON OF ELECTRICALLY DRIVEN LASERS FOR SPACE POWER TRANSMISSION
R. J. DeYoung, J. H. Lee, M. D. Williams, G. Schuster, and E. J. Conway [1988] 21 p
(NASA-TM-4045; L-16431; NAS 1.15:4045) Avail: NTIS HC A03/MF A01 CSCL 20E

High-power lasers in space could provide power for a variety of future missions such as spacecraft electric power requirements and laser propulsion. This study investigates four electrically pumped laser systems, all scaled to 1-MW laser output, that could provide power to spacecraft. The four laser systems are krypton fluoride, copper vapor, laser diode array, and carbon dioxide. Each system was powered by a large solar photovoltaic array which, in turn, provided power for the appropriate laser power conditioning subsystem. Each system was block-diagrammed, and the power and efficiency were found for each subsystem block component. The copper vapor system had the lowest system efficiency (6 percent). The CO2 laser was found to be the most readily scalable but has the disadvantage of long laser wavelength. Author

N88-23198*# David Sarnoff Research Center, Princeton, N.J.
DEVELOPMENT PROGRAM FOR 1.93-MICRON LASERS Contractor Report, 24 Sep. 1986 - 24 Sep. 1987
P. Longeway, T. Zamerowski, R. Martinelli, R. Stolzenberger, and N. DiGiuseppe Washington NASA May 1988 26 p
(Contract NAS1-17351)
(NASA-CR-4148; DSRC-88-CR-1; NAS 1.26:4148) Avail: NTIS HC A03/MF A01 CSCL 20E

For the first time lasers operating at 1.93 microns were demonstrated. The lasers were fabricated by Vapor Phase Epitaxial (VPE) growth techniques currently used for the fabrication of high power lasers at 1.3 microns. The structure of these laser diodes consisted of compositionally graded, sulfur-doped InAsP, grown on an InP substrate; a constant-composition n+ InAs(0.27)P(0.73) layer, which is the first cladding layer; an In(0.66)Ga(0.34)As layer, which is the active region, and a second InAs(0.27)P(0.73) layer. The devices were oxide-stripe DH lasers (gain-guided only). The best devices had 80 K lasing thresholds in the range of from 80 to 150 mA, and T sub o (below 220 K) in the range of 60 to 90 K. The highest observed temperature of oscillation was 15.5 C. The highest observed power output at 80 K was in the range of 3 to 5 mW. The calculated delta I/delta T was 4.4 A/K. As a part of the materials development, PIN homojunction detectors having the band edge near 1.93 were also fabricated. The best devices (100 micron diameter, mesa structure) exhibited room temperature dark currents in the range of from 20 to 50 nA and had QE at 1.93 microns in the range of 35 to 40 percent. In addition to the device results, the InGaAs-InAsP materials system was extensively investigated and low defect density layers can now be grown allowing for significant device performance improvement. Author

N88-23199# European Space Agency, Paris (France).
OPTIMIZATION OF METAL-DIELECTRIC LASER MIRRORS OF TiO2/SiO2 AND SILVER
Dirk-Roger Schmitt (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, West Germany) and Helmut Rosteck Dec. 1987 62 p Transl into ENGLISH of Optimierung von Metallisch-Dielektrischen Laserspiegeln aue der Basis von TiO2/SiO2 und Silber (Brunswick, Fed. Republic of Germany, DFVLR), Sep. 1986 61 p Original language document was announced as N87-26334
(ESA-TT-1068; DFVLR-FB-86-57; ETN-88-91975) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 22.50 DM

Laser mirrors for laser gyroscope applications were developed. The interference coatings were a combination of TiO2 and SiO2 with Ag coatings. An improvement of the cleaning process considerably improves the quality of the mirrors. A maximum value of 0.9996 for the reflectivity (R), and a minimum value of 0.00014 for the backscattering (S) are achieved. The maximum achievable R is mainly determined by the backscattering properties of the coatings. Mirrors without Ag coating have a worse S. The constancy of the coating thickness has to be improved. ESA

N88-23200# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
APPLICATION OF MAGNETIC BARRIER FOR INCREASING THE EFFICIENCY OF LASER ION SOURCE
Yu. A. Bykovskij, Yu. P. Kozyrev, V. D. Pekienkov, K. G. Suvorov, V. G. Vinogradov, A. S. Pasyuk, N. V. Pronin, and S. G. Stetsenko 1987 8 p In RUSSIAN; ENGLISH summary
(DE88-701669; JINR-R-9-87-365) Avail: NTIS (US Sales Only) HC A02/MF A01

Some results on the investigation of quantitative and spacetime characteristics of laser produced plasma dispersing in the nonuniform magnetic field are presented. The purpose of investigation was to consider a possibility of application of magnetic barrier in a laser ion source in order to rise the efficiency of ion extraction from plasma in this source. Investigations were carried out at the U-200 cyclotron and CO sub 2 laser was used. The obtained maximum pulse duration and maximum quantity of accelerated ion C sub 12 sup 3+ are 14 ms and 1.8x10 sup 10 particle/pulse, respectively. These data exceed the results obtained earlier from the laser ion sources at the U-200-cyclotron. DOE

N88-23201# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
UV-LASER REACTIONS OF MOLECULAR ADSORBATES Final Report, 21 Aug. 1984 - 20 Aug. 1987
D. J. Ehrlich and M. Rothschild 27 Dec. 1987 6 p
(Contract MIPR-ARO-131-86)
(AD-A190796; ARO-21768.6-PH) Avail: NTIS HC A02/MF A01 CSCL 07E

A technique has been developed for determining the surface diffusivity of a weakly bound adsorbate. Electron-beam-induced changes in the structure of partially amorphous CdS surfaces have been observed directly with atomic resolution. The interaction between a visible laser beam and compound semiconductors was studied; a dynamic light-guiding effect which leads to the formation of single mode slab waveguides was identified. Thin films and single crystals of metal oxides were deposited by laser-induced photochemical reactions in gas-phase and adsorbed molecules. A surface halogenation technique was developed for the photochemical etching of refractory metal films and was applied to in situ tuning of millimeter wave circuits. Laser-induced deposition of high purity tungsten was demonstrated and was applied to multi-level metallization and restructing of circuits. GRA

N88-23202# Tacan Aerospace Corp., Carlsbad, Calif.
GENERATION OF TUNABLE COHERENT RADIATION IN 3 MICROMETERS-5 MICROMETERS REGION USING SEMICONDUCTOR LASERS IN EXTERNAL CAVITIES Final Report, Aug. 1985 - Jul. 1986
Michael M. Salour Nov. 1987 32 p
(Contract F33615-85-C-2565)
(AD-A190860; AFWAL-TR-87-2075) Avail: NTIS HC A03/MF A01 CSCL 09C

This report describes the first optically pumped mode-locked PbS(1-x)Se(x) semiconductor lasers with an external cavity with the following specifications: (1) observed lasing as high as 150 K; (2) operated CW mode-locked as low as temperature of 8 K; (3) maxiumum output average power was 1 mW at 4.1 micrometers and 0.6 mW at 4.8 micrometers; (4) wavelength span from 4 micrometers to 5 micrometers are possible. GRA

N88-23203# California Univ., Santa Barbara. Quantum Inst.
THE NEW UCSB (UNIVERSITY OF CALIFORNIA, SANTA BARBARA) COMPACT FAR-INFRARED FEL Technical Report No. 2, Jan. 1986 - Jan. 1987

G. Ramian and L. Elias Nov. 1987 7 p
(Contract N00014-86-K-0692)
(AD-A190864) Avail: NTIS HC A02/MF A01 CSCL 09C

A 2 mega-volt electrostatic accelerator is being acquired by the FEL development group at UCSB. This machine is being designed to provide an exceptionally low emittance electron beam suitable for a wide range of FEL related experiments. Foremost among these will be development of a compact submillimeter FEL employing next generation electrostatic accelerator FEL concepts. It is expected that this machine will serve as prototype for a new generation of FELs all based on commercially available electrostatic accelerators ranging in voltage from .5 to 25 Megavolts. High voltage tests are expected to begin as early as 1988. GRA

N88-23204# Drexel Univ., Philadelphia, Pa. Dept. of Physics and Atmospheric Sciences.
UNSTABLE BEHAVIOR OF LASERS AND OTHER OPTICAL SYSTEMS Final Report, Oct. 1985 - Aug. 1987
L. N. Narducci, J. R. Tredicce, J. M. Yuan, and N. B. Abraham 27 Nov. 1987 63 p
(Contract DAAG29-85-K-0256)
(AD-A190875; ARO-22919.1-PH) Avail: NTIS HC A04/MF A01 CSCL 20F

This final report summarizes the theoretical and experimental activities carried out jointly by the Qauntum Optics Group at Drexel University and the Nonlinear Dynamics and Laser Physics Group at Bryn Mawr College during the period October 15, 1985 to August 31, 1987. The report includes detailed reviews of our major findings in the study of laser dynamics, especially theoretically, but also experimentally, and summaries of other parallel studies on Stimulated Raman Scattering (SRS) and nonlinear dynamics. Our emphasis has been on the formulation of a generalized version of the Maxwell-Bloch equations for the laser to include transverse degrees of freedom. We have succeeded in developing this model and have investigated in detail its steady state and linear stability properties. Our main result is the discovery of low threshold unstable behaviors and the identification of their physical origin. GRA

N88-23205# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
LASER COMPARISON STUDY OF Nd:BEL AND Nd:YAG Final Report, Dec. 1985 - Jun. 1986
Ralph C. Simpson Oct. 1987 52 p
(AD-A191084; AFWAL-TR-87-1130) Avail: NTIS HC A04/MF A01 CSCL 09C

Except for a few early instances, military tactical lasers have used Nd(3+) doped Y3Al5O12 (Nd:YAG) as the laser material. With an output wavelength of 1.064 micro and an optimum slope efficiency near 3.0 percent, the performance of this solid state material is well known (1), while the use of other materials is currently being evaluated (2,3,4). To provide an advantage over Nd:YAG, issues such as efficiency, beam quality, reliability, and availability must be considered. A study of a possible alternative to Nd:YAG was undertaken. Nd(3+) doped La2Be2O5 (Nd:BEL) was the material that was chosen. The research concentrated on relative performance parameters. What we hoped to identify were any glaring weaknesses of a material which could preclude its military use, or any significant strengths which would encourage its exploitation. To complement the data obtained, a brief discussion of spectroscopy, lasing levels, and other physical properties is included in Section 2. GRA

N88-23206# Imperial Coll. of Science and Technology, London (England). Dept. of Chemical Engineering and Chemical Technology.
[LASER INDUCED IGNITION OF PROPELLANTS] Interim Report No. 1, 1 Jun. - 31 Jul. 1987
F. B. Carleton and F. J. Weinberg 31 Jul. 1987 5 p
(Contract DAJA45-87-C-0010)
(AD-A191099) Avail: NTIS HC A02/MF A01 CSCL 21B

Central to the study of laser induced ignition of propellants is the provision of the igniting pulsed laser. Single pulses delivering in excess of 10 J energy were considered desirable. Because of the delay, the required laser which was to be obtained through BRL was not immediately available and some doubt has been expressed as to whether it would become available in the current financial year. Accordingly, an emergency plan based on attempting to revive a defunct 211A pulsed ruby laser was put into operation. This laser became non-operational some time ago, due to the leakage of cooling water through a small pin hole into the pumping flash lamp. Contrary to the manufacturers' specifications, replacement of the failed component did not cure the problem but caused the output to drop by 2 orders of magnitude to around 200mJ. GRA

N88-23207# New Mexico Univ., Albuquerque.
THIN FILM RESEARCH DIAGNOSTICS INSTRUMENTATION Final Report, 1 Jan. 1985 - 30 Jun. 1986
McNeil 21 Oct. 1987 3 p
(Grant AF-AFOSR-0091-85)
(AD-A191240; AFOSR-87-1757TR) Avail: NTIS HC A02/MF A01 CSCL 07B

All equipment purchased under this contract has been used for deposition and analysis of thin films. In particular, the Ar-ion laser is being used to investigate film scatter at multiple wavelengths. The excimer laser is being used to enhance deposition mechanisms; it illuminates a coated surface throughout film disposition. The microscope and ellipsometer are part of diagnostics used to analyze films. GRA

N88-23208# Illinois Univ., Urbana. Laser Aided Materials Processing Lab.
LASER CLADDING OF Ni, Nb AND Mg ALLOYS FOR IMPROVED ENVIRONMENTAL RESISTANCE AT HIGH TEMPERATURE Annual Progress Report, Nov. 1986 - Oct. 1987
J. Mazumder Oct. 1987 208 p
(Grant AF-AFOSR-0333-85)
(AD-A191274; AFOSR-87-1856TR) Avail: NTIS HC A10/MF A01 CSCL 11F

This report summarizes experimental and theoretical studies carried out during the period of Nov. 1986 to Oct. 1987 on laser cladding of Ni and Nb alloys for improved environmental resistance at high temperature. Major emphasis has been on Ni-Cr-Al-Hf system. Microstructural evolution and oxidation properties of these alloys were examined. For Nb alloys microstructural characterization and differential thermal analysis were carried out. A one-dimensional diffusion model for finite domain to examine the extended solid solubility in laser cladding was also developed. GRA

N88-23209# Loughborough Univ. of Technology (England).
NANOSECOND LASER PHOTOLYSIS OF OPAQUE HETEROGENEOUS PHOTOSENSITIZERS Periodic Report
F. Wilkinson Oct. 1987 5 p
(Contract DAJA45-85-C-0010)
(AD-A191424; PR-6) Avail: NTIS HC A02/MF A01 CSCL 07F

Work continues on studies of photophysical and photochemical properties of benzoylated polystyrene (polymer-bound benzophenone). We are able to establish the presence of two transients when these samples are subjected to laser flash photolysis exciting at 354 nm, from the time dependent decrease in diffuse reflectance at different analyzing wavelengths. One of these transients is the triplet state of the polymer bound benzophenone which can also be studied in emission which we were able to do. The other is probably the radical formed by hydrogen abstraction by this triplet state by those photo excited species which are close enough to methylene groups to allow reaction. GRA

N88-23210# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
EFFECTS OF TRANSLATIONAL AND ROTATIONAL NONEQUILIBRIUM ON CW (CONTINUOUS WAVE) CHEMICAL LASER PERFORMANCE
Harold Mirels 1 Mar. 1988 58 p
(Contract F04701-85-C-0086)
(AD-A191425; TR-0086A(2060)-1; SD-TR-88-40) Avail: NTIS HC A04/MF A01 CSCL 09C

A previous model used to describe continuous wave (CW) chemical laser performance is generalized to include rotational as well as translational nonequilibrium. The resultant equations are simplified by the realistic assumption that translational and rotational relaxation rates are fast compared with convection, chemical pumping, and collisional deactivation rates. As a consequence, translational and rotational relaxation rates are in equilibrium with stimulated emission. The resultant system of equations is independent of rotational relaxation. An amplifier solution is presented that predicts saturation effects in accord with experiments. Fabry-Perot oscillator solutions are also presented for a multiline saturated laser and for a partly saturated single-line laser. The present results provide a base for simplification of numerical codes. It is concluded that a reasonable first estimate for CW chemical laser performance can be obtained by assuming rotational equilibrium and translational nonequilibrium. GRA

N88-23211# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
DESIGN AND EVALUATION OF SINGLE-LOBED FAR-FIELD PATTERN LASER ARRAYS: AlGaAs/GaAs AND InGaAsP/InP SYSTEMS Ph.D. Thesis - Paul Sabatier Univ.
Sophie ColletBonnefont 1988 163 p In FRENCH; ENGLISH summary
(LAAS-88-023; ETN-88-92302) Avail: NTIS HC A08/MF A01

The design and the evaluation of phase-locked diode laser arrays with a single lobe far-field pattern for GaAs and InP systems are discussed. A general method for designing these arrays using the effective index method and the coupled mode theory is presented. The confinement required for the individual diodes is defined, and the allowed structure geometries are determined. This methodology is applied to the design of Channeled Substrate Planar (CSP) laser arrays, in order to achieve optical mode stability and high discrimination between the modes of the array. It is shown that a single-lobed far-field pattern requires technological and geometrical parameters given by a very narrow range of values. Their performances are very sensitive to the uniformity of the layers, and thermal properties prevent InGaAsP/InP CSP laser arrays from CW operation. A structure fabricated by a two step low pressure metallorganic chemical vapor deposition growth technique is proposed. The measured full width at half maximum power is 3 deg near threshold, and CW power as high as 120 mW is achieved. ESA

N88-23028# Joint Publications Research Service, Arlington, Va.
CHARACTERISTICS OF DISTRIBUTED FEEDBACK LASERS DISCUSSED
In its JPRS Report: Science and Technology. Japan 12 Nov. 1987 p 27-31 Transl. into ENGLISH from Boei Gijutsu (Tokyo, Japan), Apr. 1987 p 53-56 (For primary document see N88-23026 16-31)
Avail: NTIS HC A05/MF A01

N88-23038# Joint Publications Research Service, Arlington, Va.
EFFICIENT NARROW LINEWIDTH WAVEGUIDE DYE LASER PUMPED BY CuCl LASER
Jinrong Tang, Chunyang Jing, Guiyan Zhang, and Fucheng Lin *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 21-26 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Jul. 1987 p 399-402 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

N88-23040# Joint Publications Research Service, Arlington, Va.
INVESTIGATION OF ULTRASHORT TRAVELING-WAVE AMPLIFIED SPONTANEOUS EMISSION Abstract Only
Wenchong Li, Changlong Ning, Zuozhu Huang, Jian Chen, and Wanlun Wang *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 41 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 7, 20 Jun. 1987 p 393-398 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

N88-23041# Joint Publications Research Service, Arlington, Va.
OBSERVATION OF SYNCHRONOUSLY TRANSIENT PUMPED MODE-LOCKING DYE LASER UNDER NEGATIVE CAVITY DETUNING Abstract Only
Ningyi Luo and Hongxing Wu et al. *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 42 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 10, 20 Oct. 1987 p 583-585 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

N88-23042# Joint Publications Research Service, Arlington, Va.
DISCUSSION OF TWO-MODE TWO-PHOTON CW LASER OSCILLATION Abstract Only
Songgeng Sun *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 43 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 10, 20 Oct. 1987 p 589-593 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-23212# Technische Hogeschool, Eindhoven (Netherlands). Wind Energy Group.
PUMP ROD FORCES DUE TO HYDRODYNAMIC EFFECTS IN PISTON PUMPS Thesis
F. Verheij Oct. 1986 113 p
(PB88-164850; R-813-A) Avail: NTIS HC A06/MF A01 CSCL 13K

A mathematical model was set up to describe flow and pressure fluctuations in a pump system of a wind pump for single acting piston pumps. With this, hydrodynamic forces acting on the pump rod can be calculated. Hydrodynamic forces make an important contribution to the total pump rod force. Experiments were performed on a laboratory version of the so-called Tanzania pump. Different air volumes of the delivery airchamber, different delivery heads and different rotational speeds were chosen to obtain enough information to check the validity of the model. For the measuring and elaboration of the measurements, computer programs were developed using a new data acquisition system. Simple analytical expressions using Fourier transform analysis methods were obtained for the pressure and flow fluctuations in the pump system, from which the forces acting on the pump rod can be calculated. Author

N88-23213# Technische Hogeschool, Eindhoven (Netherlands).
ON THE COMPUTATION OF STATIONARY DETERMINISTIC BEHAVIOR OF NONLINEAR DYNAMIC SYSTEMS WITH APPLICATIONS TO ROTOR-BEARING STRUCTURES Ph.D. Thesis
Marcus Theodorus Mar Crooijmans 1987 133 p Sponsored by the Netherlands Technology Foundation
(ETN-88-92241) Avail: NTIS HC A07/MF A01

A numerical method for determining the solutions and stability of nonlinear ordinary differential equations used to model nonlinear dynamic systems is outlined. The method is based on a discrete time presentation. The combination of this method with an arc

continuation method forms a flexible tool for investigating dynamic behavior as a function of various design variables. A typical nonlinear model resulted from the study of a rotor rubbing against its housing. The dynamic behavior of the model is reported. Models of plain cylindrical bearings were used to investigate the dynamic behavior of a model, with two degrees of freedom, representing a rotor-bearing structure. The effects of various design variables on the linear stability threshold were analyzed. The periodic motions that bifurcate at the linear stability threshold were determined to show the influence of nonlinear characteristics of the bearing models. For a harmonically excited rotor, their influence on motion and stability behavior was examined. ESA

N88-23214# Institut National des Sciences Appliquees de Lyon, Villeurbanne (France). Lab. de Mecanique des Fluides et Thermique.
AERODYNAMIC AND THERMAL MODELING OF ELECTROMAGNETIC BRAKES. EVALUATION OF CONVECTIVE EXCHANGE COEFFICIENTS AND FRICTION LOSSES IN THE ROUGH WALL CHANNELS Ph.D. Thesis [MODELISATIONS AERAULIQUE ET THERMIQUE DE ROTORS DE RALENTISSEURS ELECTROMAGNETIQUES. EVALUATION DES COEFFICIENTS D'ECHANGE CONVECTIF ET DES PERTES PAR FROTTEMENT DANS DES CANAUX CORRUGUES]
Jean-Pierre Courseille 1987 96 p In FRENCH
(ISAL-ITC1-87-02; ETN-88-92013) Avail: NTIS HC A05/MF A01

The design of rotors for eddy current electromagnetic brakes applicable to heavy trucks is analyzed. The effort is concentrated on the optimization of the centrifugal blower rotor design necessary for heat dissipation. The model developed could be used as a computer assisted design by manufacturers of such devices. The introduction of roughness on the blower channel walls improves the overall heat transfer characteristics. ESA

N88-23215# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
INVESTIGATION INTO THE OPERATION OF THE NEW SPECIAL DRILLS FOR DRILLING HOLES IN THIN COMPONENTS MADE OF COMPOSITE MATERIALS
F. Zawistowski Apr. 1987 29 p
(LR-519; B8733284; ETN-88-92462) Avail: NTIS HC A03/MF A01

Drills based on the internal cone principal were tested. The axial force necessary for drilling is much smaller (3 to 5 times smaller) than for any center point drill. The heating up of the material during the drilling is negligible due to the absence of the centerpoint which has poor cutting performance. Drilling of thin and formed (not flat) components may be performed by hand drilling machine (electric or pneumatic) with controlled feed and specially adapted for this purpose. Drilling may be performed through the jig or with specially adapted or redesigned drilling machines. ESA

N88-23216*# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
SPUR GEARS: OPTIMAL GEOMETRY, METHODS FOR GENERATION AND TOOTH CONTACT ANALYSIS (TCA) PROGRAM Final Report
Faydor L. Litvin and Jiao Zhang Apr. 1988 135 p
(Grant NAG3-655)
(NASA-CR-4135; E-3940; NAS 1.26:4135; AVSCOM-TR-88-C-002) Avail: NTIS HC A07/MF A01 CSCL 13I

The contents of this report include the following: (1) development of optimal geometry for crowned spur gears; (2) methods for their generation; and (3) tooth contact analysis (TCA) computer programs for the analysis of meshing and bearing contact on the crowned spur gears. The method developed for synthesis is used for the determination of the optimal geometry for crowned pinion surface and is directed to reduce the sensitivity of the gears to misalignment, localize the bearing contact, and guarantee the favorable shape and low level of the transmission errors. A new method for the generation of the crowned pinion surface has been proposed. This method is based on application of the tool with a surface of revolution that slightly deviates from a regular cone surface. The tool can be used as a grinding wheel or as a shaver. The crowned pinion surface can also be generated by a generating plane whose motion is provided by an automatic grinding machine controlled by a computer. The TCA program simulates the meshing and bearing contact of the misaligned gears. The transmission errors are also determined. Author

N88-23217# Naval Postgraduate School, Monterey, Calif.
PATH FOLLOWING ROBOT M.S. Thesis
Steven G. Goodway Dec. 1987 329 p
(AD-A190960) Avail: NTIS HC A15/MF A01 CSCL 12I

Given a desired path to be followed by a Robot, a set of commands must be given to the Robot joint servos so that the Robot Tip, or Endpoint, can follow that path. These commands must be synchronized in time and scaled so as to maintain accuracy in the presence of possible saturations in the servos. This Thesis develops an algorithm to generate multiple simultaneous time varying commands to Robot joint positioning servos so that the Robot Tip will follow a desired path for the Cartesian and Articulated Robots. GRA

N88-23218# Naval Postgraduate School, Monterey, Calif.
AUTOMATIC CONTROL OF ROBOT MOTION M.S. Thesis
George P. Kalogiros Dec. 1987 261 p
(AD-A191012) Avail: NTIS HC A12/MF A01 CSCL 12I

The feasibility of controlling the three link rectangular and revolute robots with an adaptive computer simulation model, using a curve following technique, is investigated. Both configurations are tested for different load conditions, for rejection of random disturbances and for robustness in the case of servo motor parameter variations. The interactive nonlinear dynamics of the revolute robot, such as coupling inertia, actuator dynamics, centripetal and coriolis forces, are also investigated. First a gravity-free environment is assumed and then the robot arms are tested under gravitational torques. GRA

N88-23219*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MICROGRAVITY ROBOTICS TECHNOLOGY PROGRAM
Douglas A. Rohn, Charles Lawrence, and Andrew S. Brush (Sverdrup Technology, Inc., Cleveland, Ohio.) 1988 14 p Proposed for presentation at the ISA/88 International Conference and Exhibit, Houston, Tex., 16-21 Oct. 1988; sponsored by the Instrument Society of America
(NASA-TM-100898; E-4148; NAS 1.15:100898) Avail: NTIS HC A03/MF A01 CSCL 13I

A research program to develop technology for robots operating in the microgravity environment of the space station laboratory is described. These robots must be capable of manipulating payloads without causing them to experience harmful levels of acceleration, and the motion of these robots must not disturb adjacent experiments and operations by transmitting reactions that translate into damaging effects throughout the laboratory. Solutions to these problems, based on both mechanism technology and control strategies, are discussed. Methods are presented for reduction of robot base reactions through the use of redundant degrees of freedom, and the development of smoothly operating roller-driven robot joints for microgravity manipulators is discussed. Author

N88-23220*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTERIZED LIFE AND RELIABILITY MODELLING FOR TURBOPROP TRANSMISSIONS
M. Savage, K. C. Radil, D. G. Lewicki (Army Aviation Research and Development Command, St. Louis, Mo.), and J. J. Coy 1988 17 p Presented at the 24th Joint Propulsion Conference, Boston, Mass., 11-13 Jul. 1988; sponsored by AIAA, ASEE, ASME and SAE
(DA Proj. 1L1-61102-AH-45)

(NASA-TM-100918; E-4173; NAS 1.15:100918; AVSCOM-TR-87-C-37; AIAA-88-2979) Avail: NTIS HC A03/MF A01 CSCL 13I

A generalized life and reliability model is presented for parallel shaft geared prop-fan and turboprop aircraft transmissions. The transmission life and reliability model is a combination of the individual reliability models for all the bearings and gears in the main load paths. The bearing and gear reliability models are based on classical fatigue theory and the two parameter Weibull failure distribution. A computer program was developed to calculate the transmission life and reliability. The program is modular. In its present form, the program can analyze five different transmission arrangements. However, the program can be modified easily to include additional transmission arrangements. An example is included which compares the life of a compound two-stage transmission with the life of a split-torque, parallel compound two-stage transmission, as calculated by the computer program. Author

N88-23025# Joint Publications Research Service, Arlington, Va.
FULL ELECTRONIC CONTROL SYSTEM FOR DIESEL ENGINE
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 60-73 Transl. into ENGLISH from Jidosha Gijutsu (Tokyo, Japan), Feb. 1987 p 248-254 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

N88-23027# Joint Publications Research Service, Arlington, Va.
STATUS, TRENDS IN RESEARCH ON INTERNAL COMBUSTION ENGINES
Shoichi Furuhama *In its* JPRS Report: Science and Technology. Japan 12 Nov. 1987 p 2-26 Transl. into ENGLISH from Nainen Kikan (Tokyo, Japan), Jun. 1987 p 9-19 (For primary document see N88-23026 16-31)
Avail: NTIS HC A05/MF A01

N88-23231*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
ELECTROMAGNETIC DAMPERS FOR CRYOGENIC APPLICATIONS
Gerald V. Brown and Eliseo DiRusso *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 53-64 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

N88-23237*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MICROGRAVITY MECHANISMS AND ROBOTICS PROGRAM
Douglas A. Rohn *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 143-155 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

N88-23238*# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
BASE REACTION OPTIMIZATION OF MANIPULATORS WITH REDUNDANT KINEMATICS
C. L. Chung and S. Desa *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 157-173 (For primary document see N88-23226 16-39)
(Grant NAG3-811)
Avail: NTIS HC A20/MF A01 CSCL 13I

N88-23239*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
EVALUATION OF A HIGH-TORQUE BACKLASH-FREE ROLLER ACTUATOR
Bruce M. Steinetz *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 175-189 Previously announced as N87-16336 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

N88-23241*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
ROLLER DRIVE MATERIALS PERFORMANCE
Douglas A. Rohn *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 203-216 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

N88-23242*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MICROGRAVITY MANIPULATOR DEMONSTRATION
Andrew S. Brush (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 217-227 (For primary document see N88-23226 16-39)
(Grant NAS3-24105)
Avail: NTIS HC A20/MF A01 CSCL 13I

N88-23243*# Cellulose Conversion Enterprises, Berkeley, Calif.
ACCURATE POSITIONING OF LONG, FLEXIBLE ARM's (ARTICULATED ROBOTIC MANIPULATOR)
Michael J. Malachowski *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 129-244 (For primary document see N88-23226 16-39)
(Contract NAS3-25197)
Avail: NTIS HC A20/MF A01 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-23221# Societe Nationale Industrielle Aerospatiale, Suresnes (France). Direction Centrale de la Qualite.
DETECTION SENSITIVITY IN THICK ASSEMBLIES [SENSIBILITE DE DETECTION DANS LES ASSEMBLAGES EPAIS. PROCES-VERBAL 48-912/F]
J. Odorico and D. Lecuru 4 Aug. 1987 60 p In FRENCH
(Contract STPA-86-96-009)
(Rept-48-912/F; ETN-88-92145) Avail: NTIS HC A04/MF A01

The safe detection lengths for a very low frequency (200 Hz) eddy current method were studied. The goal was to detect cracks around the fixation bolts in thick assemblies. An algorithm was developed to obtain an analytical expression of the Weibull law from the detection probabilities for the set of the crack length classes. On average, the 90 percent safe length is 11 mm with 3.5 percent second kind error. ESA

N88-23222# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho. National Engineering Lab.
UTILITY NDE PERSONNEL QUALIFICATION/CERTIFICATION: ENHANCED PERSONNEL QUALIFICATION REQUIREMENTS FOR ASME (AMERICAN SOCIETY FOR MECHANICAL ENGINEERS) CODE SECTION 11 EXAMINATIONS
Jeffrey F. Cook Oct. 1987 5 p Presented at the American Society for Nondestructive Testing Fall Conference, Atlanta, Ga., 5 Oct. 1987 Submitted for publication
(Contract DE-AC07-76ID-01570)
(DE88-006748; EGG-M-33887; CONF-871053-1; CONF-8708227-1) Avail: NTIS HC A02/MF A01

One of the most important parts of a nondestructive examination (NDE) system, which consists of the equipment, procedure, and personnel for performing examinations, is the personnel who operate the equipment and analyze the examination results. Recent activity in Section 11 of the American Society for Mechanical

Engineers (ASME) Boiler and Pressure Vessel Code Committee to develop rules for personnel qualification for ultrasonic examinations is reviewed, and the proposed rules are compared with present day NDE personnel qualification practices. DOE

N88-23223# Columbia Univ., New York, N.Y.
STUDIES IN RELIABILITY AND INFERENCE Final Report, Oct. 1986 - Sep. 1987
H. Robbins and M. Katehakis 26 Jan. 1988 3 p
(Grant AF-AFOSR-0072-87)
(AD-A191389; AFOSR-88-0151TR) Avail: NTIS HC A02/MF A01 CSCL 12C

During this one year the grant research was continued on new problems in parameter estimation. Other research centered on the anti-search problems of target detection and on problem and models of optimal repair allocation. Finally, a mini-conference on Statical probability and Related Topics was organized. GRA

N88-23224*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
ACOUSTO-ULTRASONIC INPUT-OUTPUT CHARACTERIZATION OF UNIDIRECTIONAL FIBER COMPOSITE PLATE BY SV WAVES Final Contractor Report
Peter Liao and James H. Williams, Jr. Jun. 1988 89 p
(Grant NAG3-328)
(NASA-CR-4152; E-3996; NAS 1.26:4152) Avail: NTIS HC A05/MF A01 CSCL 14D

A unidirectional fiberglass epoxy compostie specimen is modelled as a homogeneous transversely isotropic continuum plate medium. Acousto-ultrasonic noncontact input-output characterization is studied theoretically with a transmitting and a receiving transducer located on the same face of the plate. The single reflection problem for an incident SV wave at a plane boundary in transversely isotropic medium is analyzed. An obliquely incident SV wave results in a reflected SV wave and a reflected P wave for an angle of incidence of the incident SV wave less than the critical angle. Otherwise, there exists only an SV wave in the medium as the reflected P wave degenerates into a surface wave travelling parallel to the plane boundary. The amplitude ratio of the reflected SV wave is -1 when the angle of incidence is greater than or = the critical angle. The directional dependence of the phase velocity of the SV wave propagating in the transversely isotropic medium has a significant effect on the delay time, as opposed to the directional independence of the phase velocity of a shear wave propagating in an isotropic medium. The displacements associated with the SV wave in the plate and which may be detected by the noncontact receiving transducer are approximated by an asymptotic solution for an infinite transversely isotropic medium subjected to a harmonic point load. Author

N88-23601# Bundesanstalt fuer Materialpruefung, Berlin (West Germany).
SPECTRORADIOMETRY IN MATERIALS TESTING [SPEKTRALRADIOMETRIE IN DER MATERIALPRUEFUNG]
Dietrich Grundlach *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 249-250 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N88-23225# Naval Research Lab., Washington, D.C.
REVISED IMPACT DYNAMIC DESIGN-ANALYSIS METHOD (RIDDAM)
R. L. Bory 10 Feb. 1988 90 p
(AD-A190479; NRL-MR-6123) Avail: NTIS HC A05/MF A01 CSCL 13J

Theory and examples are shown for a feasible method of estimating responses of equipment to an exercise torpedo against the hull of a submarine. The equipment is modeled as a linear and elastic system whose normal modes of vibration respond in accordance with their weight and frequency. A simple method is used for determining the effect weight of a normal model. The method is applicable to multiple models and independent motions of multiple supports. GRA

N88-23226*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LEWIS STRUCTURES TECHNOLOGY, 1988. VOLUME 1: STRUCTURAL DYNAMICS
May 1988 463 p Symposium held in Cleveland, Ohio, 24-25 May 1988
(NASA-CP-3003-Vol-1; E-3970-Vol-1; NAS 1.55:3003-Vol-1)
Avail: NTIS HC A20/MF A01 CSCL 20K

The specific purpose of the symposium was to familiarize the engineering structures community with the depth and range of research performed by the Structures Division of the Lewis Research Center and its academic and industrial partners. Sessions covered vibration control, fracture mechanics, ceramic component reliability, parallel computing, nondestructive testing, dynamical systems, fatigue and damage, wind turbines, hot section technology, structural mechanics codes, computational methods for dynamics, structural optimization, and applications of structural dynamics. For individual titles, see N88-23227 through N88-23259.

N88-23227*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
SURVEY OF IMPACT DAMPER PERFORMANCE
Gerald V. Brown *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 3-12 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

An overall picture of the impact damper is obtained by using time-history solutions of the system motion for the oscillator in free decay. The impactor behavior depends very strongly on oscillator amplitude, and free decay can sample the full range of behavior from an infinite number of impacts per cycle at high amplitude to no impacts at low amplitude. The overall picture cannot be obtained by analysis of steady-state forced response. Yet, the predictions are relevant to forced response behavior when the damping is relatively light. Three major regimes of impact behavior are shown to exist: low, middle and high amplitude ranges. Author

N88-23228*# Trumpler Associates, Inc., Westchester, Pa.
PERIODIC RESPONSE OF NONLINEAR SYSTEMS
C. Nataraj and H. D. Nelson (Arizona State Univ., Tempe.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 13-27 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A procedure is developed to determine approximate periodic solutions of autonomous and non-autonomous systems. The trignometric collocation method (TCM) is formalized to allow for the analysis of relatively small order systems directly in physical coordinates. The TCM is extended to large order systems by utilizing modal analysis in a component mode synthesis strategy. The procedure was coded and verified by several check cases. Numerical results for two small order mechanical systems and one large order rotor dynamic system are presented. The method allows for the possibility of approximating periodic responses for large order forced and self-excited nonlinear systems. Author

N88-23229*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
PIEZOELECTRIC PUSHERS FOR ACTIVE VIBRATION CONTROL OF ROTATING MACHINERY **c35**
Alan B. Palazzolo (Texas A&M Univ., College Station.) and Albert F. Kascak *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 29-46 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 14B

The active control of rotordynamic vibrations and stability by magnetic bearings and electromagnetic shakers have been discussed extensively in the literature. These devices, though effective, are usually large in volume and add significant weight to the stator. The use of piezoelectric pushers may provide similar degrees of effectiveness in light, compact packages. Tests are currently being conducted with piezoelectric pusher-based active vibration control. Results from tests performed on NASA test rigs as preliminary verification of the related theory are presented. Author

N88-23230*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Mechanical and Aerospace Engineering.
ACTIVE CONTROL AND SYSTEM IDENTIFICATION OF ROTORDYNAMIC STRUCTURE
M. L. Adams *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 47-52 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Four current research projects are summarized: (1) active control of rotor system dynamics; (2) attenuation of rotor vibration using controlled pressure hydrostatic bearings; (3) a new seal test facility for measuring isotropic and anisotropic linear rotordynamic characteristics; and (4) the use of rotordynamic instability thresholds to accurately measure bearing rotordynamic characteristics. Author

N88-23231*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
ELECTROMAGNETIC DAMPERS FOR CRYOGENIC APPLICATIONS **c37**
Gerald V. Brown and Eliseo DiRusso *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 53-64 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

Cryogenic turbomachinery of the type used to pump high-pressure liquid hydrogen at -423 F and liquid oxygen at -297 F to the main engines of the Space Shuttle are subjected to lateral rotor vibrations from unbalance forces and transient loads. Conventional dampers which utilize viscous fluids such as lubricating oil cannot be used in turbopumps because the bearing components are filled with either liquid hydrogen or liquid oxygen, which have viscosity comparable to air and, therefore, are not effective in viscous dampers. Electromagentic dampers are currently being explored as a means of providing damping in cryogenic turbopumps because their damping effectiveness increases as temperature decreases and because they are compatible with the liquid hydrogen or liquid oxygen in the turbopumps. Author

N88-23232*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MULTIGRID FOR STRUCTURES ANALYSIS
Albert F. Kascak *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 67-90 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

In structural dynamics the equations are usually expressed as finite elements. Neighbor elements need not be connected. The process of condensing a fine model into a coarse model and interpolating the low-frequency solution to the fine model is studied. Author

N88-23233*# Army Aviation Systems Command, Cleveland, Ohio. Dept. of Civil Engineering.
PARALLEL COMPUTER METHODS FOR EIGENVALUE EXTRACTION **c61**
Fred Akl (Ohio Univ., Athens.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 91-102 (For primary document see N88-23226 16-39)
(Grant NAG3-762)
Avail: NTIS HC A20/MF A01 CSCL 09B

A new numerical algorithm for the solution of large-order eigenproblems typically encountered in linear elastic finite element systems is presented. The architecture of parallel processing is used in the algorithm to achieve increased speed and efficiency of calculations. The algorithm is based on the frontal technique for the solution of linear simultaneous equations and the modified subspace eigenanalysis method for the solution of the eigenproblem. The advantages of this new algorithm in parallel computer architecture are discussed. Author

N88-23234*# Toledo Univ., Ohio. Dept. of Computer Science and Engineering.
ADAPTING HIGH-LEVEL LANGUAGE PROGRAMS FOR PARALLEL PROCESSING USING DATA FLOW **c61**
Hilda M. Standley *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 203-111 (For primary document see N88-23226 16-39)
(Grant NAG3-699)
Avail: NTIS HC A20/MF A01 CSCL 09B

EASY-FLOW, a very high-level data flow language, is introduced for the purpose of adapting programs written in a conventional high-level language to a parallel environment. The level of parallelism provided is of the large-grained variety in which parallel activities take place between subprograms or processes. A program written in EASY-FLOW is a set of subprogram calls as units, structured by iteration, branching, and distribution constructs. A data flow graph may be deduced from an EASY-FLOW program. Author

N88-23235*# Sparta, Inc., Huntsville, Ala.
ITERATIVE FINITE ELEMENT SOLVER ON TRANSPUTER NETWORKS **c61**
Albert Danial and James Watson *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 113-123 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 09B

The parallelism inherent in the Conjugate Gradient method is described. The initial results of a parallel implementation on a network of twelve transputers are discussed. The high efficiencies obtained indicate that significant speedup can be obtained with larger transputer arrays if communication overhead can be kept low. To this end, a method of communication that allows large, dynamically reconfigurable transputer arrays to exchange data in log sub 4 N steps for N processors is suggested. Author

N88-23236*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MULTIPROCESSOR GRAPHICS COMPUTATION AND DISPLAY USING TRANSPUTERS **c61**
Graham K. Ellis *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 125-140 Sponsored in part by Space Act Agreement C99066G (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 09B

A package of two-dimensional graphics routines was developed to run on a transputer-based parallel processing system. These routines were designed to enable applications programmers to easily generate and display results from the transputer network in a graphic format. The graphics procedures were designed for the lowest possible network communication overhead for increased

performance. The routines were designed for ease of use and to present an intuitive approach to generating graphics on the transputer parallel processing system. Author

N88-23237*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MICROGRAVITY MECHANISMS AND ROBOTICS PROGRAM **c37**
Douglas A. Rohn *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 143-155 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

The primary goal of this program is to produce the motion control tools necessary to enhance and enable a particular NASA mission - space laboratory-based microgravity experiments. To that end, a spectrum of technology is being developed in the disciplines of precision mechanisms and robotics. Author

N88-23238*# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mechanical Engineering.
BASE REACTION OPTIMIZATION OF MANIPULATORS WITH REDUNDANT KINEMATICS **c37**
C. L. Chung and S. Desa *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 157-173 (For primary document see N88-23226 16-39)
(Grant NAG3-811)
Avail: NTIS HC A20/MF A01 CSCL 13I

A trajectory generation method for space manipulators is introduced. The approach developed employs a manipulator with redundant kinematics. The method is implemented in two steps. First, the end-effector trajectory is developed to satisfy motion requirements. Next, the joint trajectories are developed to minimize base reactions. The analytical development of this method is described and an example illustrating the method is presented. Author

N88-23239*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
EVALUATION OF A HIGH-TORQUE BACKLASH-FREE ROLLER ACTUATOR **c37**
Bruce M. Steinetz *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 175-189 Previously announced as N87-16336 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

The results are presented of a test program that evaluated the stiffness, accuracy, torque ripple, frictional losses, and torque holding capability of a 16:1 ratio, 430 N-m (320 ft-lb) planetary roller drive for a potential space vehicle actuator application. The drive's planet roller supporting structure and bearings were found to be the largest contributors to overall drive compliance, accounting for more than half the total. In comparison, the traction roller contacts themselves contributed only 9 percent of the drive's compliance based on an experimentally verified stiffnesss model. Torque ripple tests showed the drive to be extremely smooth, actually providing some damping of input torsional oscillations. The drive also demonstrated the ability to hold static torque with drifts of 7 arc sec or less over a 24-hour period at 35 percent of full load. Author

N88-23240*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
LOW-COST OPTICAL DATA ACQUISITION SYSTEM FOR BLADE VIBRATION MEASUREMENT **c35**
Stephen J. Posta *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 191-202 Previously announced as N87-14730 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 14B

A low cost optical data acquisition system was designed to measure deflection of vibrating rotor blade tips. The basic principle of the new design is to record raw data, which is a set of blade arrival times, in memory and to perform all processing by software following a run. This approach yields a simple and inexpensive system with the least possible hardware. Functional elements of the system were breadboarded and operated satisfactorily during rotor simulations on the bench, and during a data collection run with a two-bladed rotor in the Lewis Research Center Spin Rig. Software was written to demonstrate the sorting and processing of data stored in the system control computer, after retrieval from the data acquisition system. The demonstration produced an accurate graphical display of deflection versus time. Author

N88-23241*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
ROLLER DRIVE MATERIALS PERFORMANCE **c37**
Douglas A. Rohn *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 203-216 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 13I

Roller traction performance basics, a test program to measure performance, and the need for and typical use of the information are outlined. A test rig was designed and fabricated to develop this information. Parametric conditions and specimen materials were chosen so that the resulting data will be valuable to the design and development of advanced, roller-driven space mechanisms, from precision positioning devices to telerobot joints. Author

N88-23242*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MICROGRAVITY MANIPULATOR DEMONSTRATION **c37**
Andrew S. Brush (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 217-227 (For primary document see N88-23226 16-39)
(Grant NAS3-24105)
Avail: NTIS HC A20/MF A01 CSCL 13I

A test rig is being developed that will be used to demonstrate and evaluate approaches to limiting manipulator base reactions in microgravity environments. The demonstration will include a 4-degrees-of-freedom arm, control computing facilities, and a base reaction measurement system. Author

N88-23243*# Cellulose Conversion Enterprises, Berkeley, Calif.
ACCURATE POSITIONING OF LONG, FLEXIBLE ARM's (ARTICULATED ROBOTIC MANIPULATOR) **c37**
Michael J. Malachowski *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 129-244 (For primary document see N88-23226 16-39)
(Contract NAS3-25197)
Avail: NTIS HC A20/MF A01 CSCL 13I

An articulated robotic manipulator (ARM) system is being designed for space applications. Work being done on a concept utilizing an infinitely stiff laser beam for position reference is summarized. The laser beam is projected along the segments of the ARM, and the position is sensed by the beam rider modules (BRM) mounted on the distal ends of the segments. The BRM concept is the heart of the system. It utilizes a combination of lateral displacements and rotational and distance measurement sensors. These determine the relative position of the two ends of the segments with respect to each other in six degrees of freedom. The BRM measurement devices contain microprocessor controlled data acquisition and active positioning components. An indirect adaptive controller is used to accurately control the position of the ARM. Author

N88-23244*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
DEVELOPMENT OF AEROELASTIC ANALYSIS METHODS FOR TURBOROTORS AND PROPFANS, INCLUDING MISTUNING
Krishna Rao V. Kaza *In* NASA, Lewis Research Center, Lewis

Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 247-262 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

The NASA Lewis aeroelastic research program is focused on unstalled and stalled flutter, forced response, and whirl flutter of turborotors and propfans. The objectives are to understand the physical phenomena of cascade flutter and response including blade misturing. Author

N88-23245*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
THE 2-D AND 3-D TIME MARCHING TRANSONIC POTENTIAL FLOW METHOD FOR PROPFANS **c02**
Marc H. Williams *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 263-271 (For primary document see N88-23226 16-39)
(Grant NAG3-499)
Avail: NTIS HC A20/MF A01 CSCL 01A

Recent efforts concentrated on the development of aerodynamic tools for the analysis of rotors at transonic speeds and of configurations involving relative rotation. Three distinct approaches were taken: (1) extension of the lifting surface method of Williams and Hwang (1986) to relative rotation; (2) development of a time marching linear potential method for counter rotation; and (3) development of 2 and 3 dimensional finite volume potential flow schemes for single rotation. Results from each of these approaches are described. Author

N88-23246*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
PROPFAN MODEL WIND TUNNEL AEROELASTIC RESEARCH RESULTS **c02**
Oral Mehmed *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 273-286 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 01A

Some of the single rotation propfan model wind tunnel aeroelastic findings from the experimental part of this research program are described. These findings include results for unstalled or classical flutter, blade response from separated flow excitations, and blade response from aerodynamic excitations at angled inflow conditions. Author

N88-23247*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
AEROELASTIC FORCED RESPONSE ANALYSIS OF TURBOMACHINERY **c07**
Todd E. Smith (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 287-297 (For primary document see N88-23226 16-39)
(Contract NAS3-24105)
Avail: NTIS HC A20/MF A01 CSCL 21E

An introduction is given to the research activity that is underway to enable the prediction of turbomachinery aeroelastic forced response. An effort is being made to assemble a computer program (FREPS) which incorporates the aeroelastic structural models, unsteady aerodynamic models, and forcing function models. The structural and aerodynamic models are currently well developed. The forcing function models are at a primitive level. A significant activity has begun to identify the forcing functions due to stator-rotor aerodynamic interaction. Author

N88-23248*# Duke Univ., Durham, N. C. Dept. of Mechanical Engineering and Materials Science.
REDUCED ORDER MODELS FOR NONLINEAR AERODYNAMICS **c02**
Aparajit J. Mahajan, Earl H. Dowell, and Donald B. Bliss *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 299-308 (For primary document see N88-23226 16-39)
(Grant NAG3-724)
Avail: NTIS HC A20/MF A01 CSCL 01A

Reduced order models are needed for reliable, efficient and accurate prediction of aerodynamic forces to analyze fluid structure interaction problems in turbomachinery, including propfans. Here, a finite difference, time marching Navier-Stokes code is validated for unsteady airfoil motion by comparing results with those from classical potential flow. The Navier-Stokes code is then analyzed for calculation of primitive and exact estimates of eigenvalues and eigenvectors associated with fluid-airfoil interaction. A variational formulation for the Euler equations and Navier-Stokes equations will be the basis for reduction of order through an eigenvector transformation. Author

N88-23249*# Georgia Inst. of Tech., Atlanta.
APPLICATION OF NAVIER-STOKES ANALYSIS TO STALL FLUTTER **c08**
J. C. Wu, R. Srivastava, and L. N. Sankar *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 309-320 (For primary document see N88-23226 16-39)
(Grant NAG3-730)
Avail: NTIS HC A20/MF A01 CSCL 01A

A solution procedure was developed to investigate the two-dimensional, one- or two-dimensional flutter characteristics of arbitrary airfoils. This procedure requires a simultaneous integration in time of the solid and fluid equations of motion. The fluid equations of motion are the unsteady compressible Navier-Stokes equations, solved in a body-fitted moving coordinate system using an approximate factorization scheme. The solid equations of motion are integrated in time using an Euler implicit scheme. Flutter is said to occur if small disturbances imposed on the airfoil attitude lead to divergent oscillatory motions at subsequent times. The flutter characteristics of airfoils in subsonic speed at high angles of attack and airfoils in high subsonic and transonic speeds at low angles of attack are investigated. The stall flutter characteristics are also predicted using the same procedure. Author

N88-23250*# Toledo Univ., Ohio.
A COMPUTATIONAL PROCEDURE FOR AUTOMATED FLUTTER ANALYSIS **c08**
Durbha V. Murthy *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 323-336 Previously announced as N87-28058 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 01A

A direct solution procedure for computing the flutter Mach number and the flutter frequency is applied to the aeroelastic analysis of propfans using an unsteady aerodynamic model based on a three-dimensional subsonic compressible lifting surface theory. An approximation to the Jacobian matrix that improves the efficiency of the iterative process is presented. The Jacobian matrix is indirectly approximated from approximate derivatives of the flutter matrix. Examples are used to illustrate the convergence properties. The direct solution procedure facilitates the automated flutter analysis in addition to contributing to the efficient use of computer time as well as the analyst's time. Author

N88-23251*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
CHARACTERIZATION OF STRUCTURAL CONNECTIONS FOR MULTICOMPONENT SYSTEMS
Charles Lawrence and Arthur A. Huckelbridge (Case Western Reserve Univ., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 337-352 Previously announced as N88-18974 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

This study explores combining Component Mode Synthesis methods for coupling structural components with Parameter Identification procedures for improving the analytical modeling of the connections. Improvements in the connection stiffness and

damping properties are computed in terms of physical parameters so that the physical characteristics of the connections can be better understood, in addition to providing improved input for the system model. Author

N88-23252*# Michigan Univ., Ann Arbor.
MIXED FINITE ELEMENT FORMULATION APPLIED TO SHAPE OPTIMIZATION **c64**
Helder Rodrigues, John E. Taylor, and Noboru Kikuchi *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 353-365 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 12A

The development presented introduces a general form of mixed formulation for the optimal shape design problem. The associated optimality conditions are easily obtained without resorting to highly elaborate mathematical developments. Also, the physical significance of the adjoint problem is clearly defined with this formulation. Author

N88-23253*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MODAL FORCED RESPONSE OF PROPFANS IN YAWED FLOW
G. V. Narayanan (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 367-376 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A modal forced response method for propfans in yawed flow is presented. This capability exists in the Aeroelastic Stability and Response of Propfan (ASTROP3) code developed at the Lewis Research Center. The code uses three-dimensional steady and unsteady cascade aerodynamics by Williams and Hwang (1986) and a NASTRAN finite element model to represent the blade structure. In addition, many utility programs exist in ASTROP3 that help in both the preprocessing of the NASTRAN model and the postprocessing of modal response results. The postprocessing work that computes the blade vibratory displacements and stresses in yawed flow are highlighted here. Author

N88-23254*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
VIBRATION AND FLUTTER ANALYSIS OF THE SR-7L LARGE-SCALE PROPFAN
Richard August (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 379-392 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A structural and aeroelastic analysis of the SR-7L advanced turboprop is presented. Analyses were conducted for several cases at different blade pitch angles, blade support conditions, rotational speeds, free-stream Mach numbers, and number of blades. A finite element model of the final blade design was used to determine the blade's vibration behavior and its sensitivity to support stiffness. A computer code which was based on three-dimensional, subsonic, unsteady lifting surface aerodynamic theory, was used for the aeroelastic analysis to examine the blade's stability at a cruise condition of Mach 0.8 at 1700 rpm. The results showed that the calculated frequencies and mode shapes obtained agreed well with the published experimental data and that the blade is stable for that operating point. Author

N88-23255*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
SUPERSONIC AXIAL-FLOW FAN FLUTTER
John K. Ramsey *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 393-403 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Lane's (1957) analytical formulation of the unsteady pressure distribution on an oscillating two-dimensional flat plate cascade in supersonic axial flow has been developed into a computer code. This unsteady aerodynamic code has shown good agreement with other published data. This code has also been incorporated into an existing aeroelastic code to analyze the NASA Lewis supersonic through-flow fan design. Author

N88-23256*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
STALL FLUTTER ANALYSIS OF PROPFANS
T. S. R. Reddy (Toledo Univ., Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 405-419 Previously announced as N87-18883 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

Three semi-empirical aerodynamic stall models are compared with respect to their lift and moment hysteresis loop prediction, limit cycle behavior, easy implementation, and feasibility in developing the parameters required for stall flutter prediction of advanced turbines. For the comparison of aeroelastic response prediction including stall, a typical section model and a plate structural model are considered. The response analysis includes both plunging and pitching motions of the blades. In model A, a correction of the angle of attack is applied when the angle of attack exceeds the static stall angle. In model B, a synthesis procedure is used for angles of attack above static stall angles, and the time history effects are accounted for through the Wagner function. Author

N88-23257*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
SSME SINGLE-CRYSTAL TURBINE BLADE DYNAMICS
Larry A. Moss (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 421-430 Previously announced as N87-26384 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

A study was performrd to determine the dynamic characteristics of the Space Shuttle Main Engine high pressure fuel turbopump (HPFTP) blades made of single crystal (SC) material. The first and second stage drive turbine blades of HPFTP were examined. The nonrotating natural frequencies were determined experimentally and analytically. The experimental results of the SC second stage blade were used to verify the analytical procedures. The study examined the SC first stage blade natural frequencies with respect to crystal orientation at typical operating conditions. The SC blade dynamic response was predicted to be less than the directionally solidified base. Crystal axis orientation optimization indicated that the third mode interference will exist in any SC orientation. Author

N88-23258*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
PARAFRASE RESTRUCTURING OF FORTRAN CODE FOR PARALLEL PROCESSING **c61**
Atul Wadhwa (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 431-447 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 09B

Parafrase transforms a FORTRAN code, subroutine by subroutine, into a parallel code for a vector and/or shared-memory multiprocessor system. Parafrase is not a compiler; it transforms a code and provides information for a vector or concurrent process. Parafrase uses a data dependency to reveal parallelism among instructions. The data dependency test distinguishes between recurrences and statements that can be directly vectorized or parallelized. A number of transformations are required to build a data dependency graph. Author

N88-23259*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
ANALYSIS OF ROTATING FLEXIBLE BLADES USING MSC/NASTRAN
Michael A. Ernst *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 449-464 Previously announced as N87-21375 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 20K

An overview is given of the use of MSC/NASTRAN in the analysis of rotating flexible blades. The geometrically nonlinear analysis using NASTRAN Solution Sequence 64 is discussed along with the determination of frequencies and mode shapes using Solution Sequence 63. Items unique to rotating blade analysis, such as setting angle, centrifugal softening effects, and hub flexibility, are emphasized. Author

N88-23260# Maine Dept. of Transportation, Augusta. Technical Services Div.
SEASONAL VARIATION FOR STRUCTURAL STRENGTH VALUE Final Report
D. A. Madden Jun. 1987 77 p Sponsored by Federal Highway Administration, Augusta, Maine
(PB88-169248; TR-87-2; FHWA/ME-87/2) Avail: NTIS HC A05/MF A01 CSCL 20K

The initial effort relative to determining the variation in material strengths due to climatic conditions are presented. Deflection measurements were obtained over a two year period on fifteen selected Federal Aid projects all of which had a total structure depth (total of base and bituminous layers) of 24 to 30 inches. During the second year of the study five lighter designed State Aid roadway sections were randomly selected and tested. Data were obtained throughout the year(s) with emphasis on the spring breakup period (March-April). The data were analyzed statistically and are displayed both in tabular and graphic form for several parameters. Relative comparisons of overall deflections, deflection fluctuation, and deflection bowl configurations are discussed for the various test sections. GRA

N88-23261# Technische Hogeschool, Delft (Netherlands).
ON THE CALCULATION OF STRESSES IN PIN-LOADED ANISOTROPIC PLATES Ph.D. Thesis
Theo deJong 1987 137 p
(ETN-88-92239) Avail: NTIS HC A07/MF A01

A method for the calculation of stresses in an anisotropic plate with a row of equally spaced, pin-loaded holes is presented. The pin-plate configuration represents a joint in a composite laminate where load is transferred from a row of bolts or rivets into the laminate. The method of solution is based on Lekhnitskii's theory of complex variable functions. The boundary conditions of the problem are satisfied in the approximate sense employing a numerical method. Numerical results show the effects of the relevant parameters of the problem. ESA

N88-23262# Technische Hogeschool, Delft (Netherlands).
MODELS IN NONLINEAR THERMOMECHANICS. FINITE ELEMENT MODELS AND CONSTITUTIVE MODELS FOR LARGE DEFORMATION ELASTOPLASTICITY Ph.D. Thesis
Erik vanderGiessen 1987 156 p
(ETN-88-92240) Avail: NTIS HC A08/MF A01

Finite element models for the discrete description of the thermomechanical behavior of continua are discussed. The approach constitutes an alternative to commonly adopted Galerkin methods in conjunction with numerical integration. Application to problems of large deformation elastoplasticity according to a material and a spatial approach is discussed. Two-dimensional problems of incompressible viscous fluid flow and heat flow illustrate the theory. The so-called redundant pressure method is presented as a solution method for handling the incompressibility constraints. Constitutive models for large deformation elasto-plasticity are derived from the general constitutive theory for materials possessing a natural reference state. Based upon the concept of a plastically induced orientational structure, a relatively simple and reasonably specific constitutive theory which accounts explicitly for the progressive development of anisotropy during plastic deformation processes is presented. ESA

N88-23263# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Abteilung Betriebsnahe Ermuedungsfestigkeit.
FATIGUE CRACK GROWTH UNDER FULL-SCALE CYCLIC PLASTICITY
Roelof Marissen, Aref Nurtjaho, Karl-Heinz Trautmann, and Horst Nowack Oct. 1987 53 p Sponsored by Deutsches Forschungsgemeinschaft
(DFVLR-FB-87-48; ISSN-0171-1342; ETN-88-92320) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 20.50 DM

Fatigue growth tests were performed on edge notched aluminum alloy sheet specimens under large-scale cyclic yielding conditions. Stable mechanical testing conditions were obtained by strain control of the testing machine. A phenomenological description of results, like crack growth rates, fracture mode transition, and crack opening level is presented. The test conditions cause the crack to open under loads which are still compressive. ESA

N88-23264# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
APPLICATION OF THE ONERA MODEL TO THE LIFE ESTIMATION UNDER FATIGUE CRACKING OF A Al-Li ALLOY. PARAMETER IDENTIFICATION AND TEST-EXPERIMENT COMPARISON UNDER FALSTAFF LOADING Final Report [APPLICATION DU MODELE ONERA DE PREVISION DE DUREE DE VIE EN FISSURATION DE FATIGUE SUR UN ALLIAGE ALUMINIUM-LITHIUM. IDENTIFICATION DES PARAMETRES ET COMPARAISON ESSAI-PREDICTION SOUS CHARGEMENT FALSTAFF]
G. Baudin Feb. 1987 34 p In FRENCH
(Contract DRET-86-34-001)
(ONERA-RT-32/7169-RY-063-R; ETN-88-92140) Avail: NTIS HC A03/MF A01

The model threshold functions F1 and F2 were determined in order to test the extension of light alloy aircraft construction materials to Al-Li alloys. Fatigue analysis was carried out on 2 mm thick plate specimens. The fatigue life estimation is 26 percent higher than experiment, which is acceptable for a first result. ESA

N88-23265# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
A NONLINEAR COMPUTATION FOR COMPOSITE STRUCTURES Final Report [UN MODULE DE CALCUL NON LINEAIRE POUR LES STRUCTURES COMPOSITES]
R. Girard Mar. 1987 40 p In FRENCH
(Contract DRET-86-34-001)
(ONERA-RT-15/3542-RY-062-R; ETN-88-92141) Avail: NTIS HC A03/MF A01

A procedure based on total Lagrangian implementation, where the nonlinear problem is solved numerically by increment and iteration (Newton method with load increments) is presented. The finite element model is general enough to allow the analysis of large structures built with composite materials. Algorithms and computation strategies are compared. ESA

N88-23266# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction Scientifique de la Resistance des Structures.
CRACK RETARDATION UNDER LOAD SPECTRA. EXPERIMENTAL STUDY AND NUMERICAL SIMULATION USING THE SIMPLIFIED K CONSTANT MODEL Final Report [RALENTISSEMENT DE LA VITESSE DE FISSURATION OBSERVE SOUS SPECTRE DE CHARGES; ETUDE EXPERIMENTALE SOUS SPECTRE SIMPLIFIE K CONSTANT ET SIMULATION NUMERIQUE]

L. Anquez, G. Baudin, and M. Robert Dec. 1987 43 p In FRENCH
(Contract STPA-85-95-004)
(ONERA-RT-30/7169-RY-054-R; ETN-88-92142) Avail: NTIS HC A03/MF A01

The slowing down of crack propagation under the TWIST and MiniTWIST load spectra is studied. An experimental parametric study allows the identification of the main parameters. Numerical simulation was carried out using the Newman elastoplastic model. The conclusion is that only very sophisticated models can explain the phenomena. ESA

N88-23267# GKSS-Forschungszentrum Geesthacht (West Germany). Inst. fuer Werkstofforschung.
ENVIRONMENT EFFECTS ON CRACK PROPAGATION WITH TENSILE STRESS
W. Dietzel and K.-H. Schwalbe 1987 63 p In GERMAN; ENGLISH summary
(GKSS-87/E/46; ISSN-0344-9629; ETN-88-92340) Avail: NTIS HC A04/MF A01

The stress corrosion cracking of two aluminum alloys (Al2024, Al7075) and of two steels (20MnMoNi55, N-A-Xtra 70) was investigated using constant load, constant displacement, and constant displacement rate and precracked CT and DCB-specimens. Tests at constant displacement rates (with displacement rates down to 0.1 micron/hr) required the development of suitable measuring and controlling systems and procedures. Facilities for testing under ultrahigh vacuum conditions as a reference environment were established. ESA

N88-23268# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
ON THE CALCULATION OF STRESSES IN PIN-LOADED ANISOTROPIC PLATES
T. deJong Nov. 1987 132 p
(LR-529; B8733280; ETN-88-92469) Avail: NTIS HC A07/MF A01

A method for the calculation of stresses in an anisotropic plate with a row of equally spaced, pin-loaded holes, as in a joint in a composite laminate where load is transferred from a row of mechanical fasteners into the laminate, is presented. The problem is of the mixed-boundary type. The solution can be considered to be an application of Lekhnitskii's theory on stress distributions in anisotropic plates with holes. With this theory the determination of the stresses can be reduced to the determination of two complex functions which must satisfy the specified boundary conditions of the problem. Numerical results for combinations of parameters which specify a large number of joints in terms of geometry, material properties, and loading mode of the holes are correlated with results from literature. It is illustrated how the stresses in a joint with two or more rows of pin-loaded holes can be approximated using the solution for a single row plus a bypass factor. ESA

N88-23269# California Univ., Richmond. Earthquake Engineering Research Center.
EFFECTS OF AXIAL LOAD ON ELASTOMERIC ISOLATION BEARINGS
C. G. Koh and J. M. Kelly Nov. 1987 108 p
(Grant NSF ECE-84-14036)
(PB88-179015; UCB/EERC-86/12; NSF/ENG-86018) Avail: NTIS HC A06/MF A01 CSCL 20K

The viscoelastic behavior of elastomeric isolation bearings is studied with the effects of axial load taken into consideration. First, two series solution are presented for computing the compression stiffness of bonded square layers accounting for compressibility. For typical square rubber layers, these solutions justify a simplified approach. The latter is then extended to obtain the effective bending stiffness. Then with this effective stiffness of elastomeric bearings, two viscoelastic axial load models are proposed. The first model is consistent with Haringx's theory, utilizing the eigenvalue solutions of the corresponding buckling problem. The convergence of the series involved is very rapid, leading to the first mode consistent model. The second model is a simplified physical model dealing with only two springs to reproduce the essential features of the previous model. The reduction of the dynamic shear stiffness, the increased damping and the height reduction of bearings due to the axial load effect are obtained. The corresponding experimental program was carried out and both models are shown to give good correlations.
Author

N88-23270# Oak Ridge National Lab., Tenn.
COMPUTER SIMULATION OF A MOTOR PUMP UNIT TO AID IN INTERPRETING VIBRATION DATA
N. E. Clapp and B. Damiano 1988 13 p Presented at the Southeastcon '88 Conference and Exhibit, Knoxville, Tenn., 11 Apr. 1988
(Contract DE-AC05-84OR-21400)
(DE88-004481; CONF-880433-3) Avail: NTIS HC A03

While measuring vibrations to analyze rotating machinery conditions is an accepted industry practice, the amount of data required is large and time-consuming to collect. Another approach for predicting vibration signatures due to component failures or changes under operating conditions is being performed in the Instrumentation and Controls Division of the Oak Ridge National Laboratory. Using a dynamic computer model of the rotating machine, a variety of natural modes of oscillations can be simulated. Results are analyzed using a Fast Fourier Transform code to generate spectra that show changes in spectral shapes caused by the simulated anomalies. DOE

N88-23271# Georgia Inst. of Tech., Atlanta. Mechanical Properties Research Lab.
STUDY OF MECHANISMS OF TIME-DEPENDENT CRACK GROWTH AT ELEVATED TEMPERATURE Annual Progress Report No. 2, 16 Feb. 1987 - 15 Feb. 1988
A. Saxena, S. R. Stock, B. Gieseke, and K. Banerji 25 Feb. 1988 35 p
(Contract DE-FG05-86ER-45257)
(DE88-006918; DOE/ER-45257/T1) Avail: NTIS HC A03/MF A01

The objective of this study is to conduct creep and creep-fatigue crack growth tests and to characterize the crack tip damage mechanisms in a model material (copper with 1 wt percent antimony) which is known to cavitate at the grain boundaries under creep deformation. The above data and observations will be used to develop mechanistic models for cumulative crack tip damage under complex loading conditions at elevated temperatures. The application of these models will also be extended to situations involving non-periodic loading. DOE

N88-23272*# Illinois Univ., Chicago. Dept. of Civil Engineering, Mechanics and Metallurgy.
ON GOVERNING EQUATIONS FOR CRACK LAYER PROPAGATION Final Report
A. Chudnovsky and J. Botsis Apr. 1988 27 p
(Grant NAG3-754)
(NASA-CR-182120; NAS 1.26:182120) Avail: NTIS HC A03/MF A01 CSCL 20K

Results of analysis on damage distribution of a crack layer, in a model material, supported the self-similarity hypothesis of damage evolution which has been adopted by the crack layer theory. On the basis of measurements of discontinuity density and the double layer potential technique, a solution to the crack damage interaction problem has been developed. Evaluation of the stress intensity factor illustrated the methodology. Analysis of experimental results showed that Arrhenius type constitutive relationship described very well the expansion of the active zone of a crack layer. Author

N88-23273*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INTEGRATED MULTIDISCIPLINARY ANALYSIS TOOL IMAT USERS' GUIDE
Frances T. Meissner, ed. Apr. 1988 226 p
(NASA-TM-100605; NAS 1.15:100605) Avail: NTIS HC A11/MF A01 CSCL 20K

The Integrated Multidisciplinary Analysis Tool (IMAT) is a computer software system developed at Langley Research Center. IMAT provides researchers and analysts with an efficient capability to analyze satellite controls systems influenced by structural dynamics. Using a menu-driven executive system, IMAT leads the user through the program options. IMAT links a relational database manager to commercial and in-house structural and controls analysis codes. This paper describes the IMAT software system and how to use it. Author

N88-23274# Northwestern Univ., Evanston, Ill. Structural Mechanics Lab.
HEATING AT A PROPAGATING CRACK TIP IN A VISCOPLASTIC MATERIAL Interim Report
J. C. Sung and J. D. Achenbach Sep. 1987 21 p
(Contract N00014-85-K-0401)
(AD-A190952; NU-SML-TR-87-3) Avail: NTIS HC A03/MF A01 CSCL 20K

The crack tip temperature due to near-tip dissipation of mechanical energy has been calculated for a crack propagating in a viscoplastic material. The mechanical behavior of the material was represented by a model proposed by Bodner and Partom. On the basis of the adiabatic approximation the maximum temperature has been investigated as a function of the crack-tip speed and the material parameters. For a specific crack-tip speed, T sub max is displayed as a function of the material constant, D sub o, which defines the asymptotic limit of the inelastic strain rate as the stress level increases. The maximum temperature increases with increasing values of D sub o. GRA

N88-23275# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
BIMODULAR BEHAVIOR AND CRACK CLOSURE IN COMPRESSION IN A BRITTLE MATERIAL
L. A. Feldman 30 Sep. 1987 22 p
(Contract F04701-85-C-0086)
(AD-A191267; TOR-0086(6728-02)-3) Avail: NTIS HC A03/MF A01 CSCL 20K

A vibrating beam method was used to determine the elastic modulus of graphite rods. The frequency and apparent modulus were determined as a function of compressive end loading. Following fracture of the rod, the frequency and apparent modulus were decreased. At a compressive end loading of about 0.83 MPa (120 psi), crack closure was sufficient for the fractured rod to behave similarly in vibration to the unfractured rod. Thus, the fractured material behaves in a bimodular fashion and crack closure can be achieved to enable unimpeded stress transfer across the fracture surface during vibration. GRA

N88-23276*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A FINITE-ELEMENT ALTERNATING METHOD FOR TWO-DIMENSIONAL MODE-1 CRACK CONFIGURATIONS
I. S. Raju (Analytical Services and Materials, Inc., Hampton, Va.) and W. B. Fichter May 1988 48 p
(NASA-TM-100616; NAS 1.15:100616) Avail: NTIS HC A03/MF A01 CSCL 20K

A finite-element alternating method is presented for 2-D Mode-1 crack problems. An analytical solution for an arbitrary polynomial normal pressure distribution applied to the crack faces is obtained and used as the basic solution in the method. The method is applied to several crack problems to study its efficiency and the results are compared to accurate stress-intensity factor solutions in the literature. The method gave reasonably accurate stress-intensity factors and crack opening displacements with minimal computing effort. Because the method must model only the uncracked body, finite-element models with many degrees of freedom are not warranted and therefore, the method has been implemented on personal computers. Author

N88-23277# Institut National de Recherche d'Informatique et d'Automatique, Le Chesnay (France).
CALCULATION OF DISPLACEMENT, CONSTRAINTS AND EIGENMODES OF ROTATING BLADES Final Report [CALCUL DE DEPLACEMENTS, CONTRAINTES, MODES PROPRES DE PALES TOURNANTES]
Michel Bernadou and Bernard Lalanne 1987 124 p In FRENCH
(Contracts DRET-83-322; DRET/INRIA-15/84-01-1103-1)
(ETN-88-92296) Avail: NTIS HC A06/MF A01

A numerical simulation method for free vibration motions of thin shells of any shape is presented. The method is based on the thin shell equations of Koiter (1959, 1966) based on the representation of the average shell surface using general curved coordinates. Approximation by B-splines to interpolate the shell surface and thickness; a nonlinear equation dynamic model for thin shells; an increment method; and the free vibration equations for the shells are described. For each stage, existence and uniqueness results, finite element methods, and ways to implement them are shown. The methods were applied to calculate the displacements, constraints, and eigenmodes of free vibration of turbine and compressor blades. ESA

N88-23278*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD AND MODELS FOR R-CURVE INSTABILITY CALCULATIONS
Thomas W. Orange 1988 13 p Presented at the 21st National Symposium on Fracture Mechanics, Annapolis, Md., 28-30 Jun. 1988; sponsored by the American Society for Testing and Materials
(NASA-TM-100935; E-4212; NAS 1.15:100935) Avail: NTIS HC A03/MF A01 CSCL 20K

This paper presents a simple method for performing elastic R-curve instability calculations. For a single material-structure combination, the calculations can be done on some pocket calculators. On microcomputers and larger, it permits the development of a comprehensive program having libraries of driving force equations for different configurations and R-curve model equations for different materials. The paper also presents several model equations for fitting to experimental R-curve data, both linear elastic and elastoplastic. The models are fit to data from the literature to demonstrate their viability. Author

N88-22991 Joint Publications Research Service, Arlington, Va.
DURABILITY OF COMPOUND CYLINDER UNDER STATIC INTERNAL-PRESSURE REPEAT LOAD OF LONG DURATION Abstract Only
G. P. Zaytsev, G. V. Arkhipov, and N. M. Kopyl *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 7 Transl. into ENGLISH from Problemy Prochnosti (Kiev, USSR), no. 5, May 1987 p 42-47 Original language document was announced in IAA as A87-43639 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-23279# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
CONTRIBUTIONS TO GEODESY, PHOTOGRAMMETRY AND CARTOGRAPHY. SERIES 1, NUMBER 46
1987 235 p Presented at the 13th International Cartographic Association (ICA) Conference on Cartography, Morelia, Mexico, 1987 Original contains color illustrations Maps as supplement (ISSN-0469-4244; ETN-88-92386) Avail: NTIS HC A11/MF A01

Cartography as a management and planning tool; cartography as a communication process; cartographic technology, map compilation and revision; education in cartography; thematic and resources mapping; tourism; urban cartography; and maps for the blind are discussed. For individual titles, see N88-23280 through N88-23298.

N88-23280# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
REPORT ON THE CARTOGRAPHIC ACTIVITIES OF THE FEDERAL REPUBLIC OF GERMANY IN THE PERIOD 1984 - 1987
Ulrich Freitag *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 5-29 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Theoretical research, field work, and publishing activities of map makers in West Germany are reviewed. ESA

N88-23281# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INVENTORY OF TOPOGRAPHIC MAPPING AND STANDARDIZATION OF GEOGRAPHIC NAMES AS THE BASIS OF A GEOGRAPHIC INFORMATION SYSTEM (GIS)
Rolf Boehme *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 31-39 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

It is argued that an inventory of topographic maps (1:25,000, 1:50,000 and 1:100,000) has to be made prior to data acquisition for a geographic information system (GIS). With the SPOT satellite, there exists the possibility of filling gaps in topographic mapping at 1:50,000 scale in developing countries, especially in less densely populated areas. Satellite imagery provides a basis for a GIS. Spatiocart compiled from SPOT imagery is a substitute for topographic maps, yet it lacks geographic names. Hence the collection of geographical names, after the United Nations standard, is essential for making available the fundamental material that contains all the data necessary to locate and identify the various items in a GIS. ESA

N88-23282# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTER AIDED CARTOGRAPHIC REPRESENTATION OF TRAFFIC DATA: THE TRAFFIC INTENSITY MAPS OF BADEN-WUERTTEMBERG (FEDERAL REPUBLIC OF GERMANY)
Hans F. Kern and Heinz Morhard *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 41-50 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Semiautomatic preparation of road traffic intensity maps is described. Methods of relating the existing road data banks to the results of the road traffic census for the state information system are shown. ESA

N88-23283# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
DO WE NEED A NEW CARTOGRAPHY?
Ulrich Freitag *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 51-59 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

The meanings of the words new, cartography and mapping are explained. The implications of technological changes for cartography are assessed. The social responsibility of cartographers is discussed. ESA

N88-23284# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTER-ASSISTED SYMBOLIZATION BY RASTER DATA PROCESSING
Ernst Jaeger *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 61-70 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

The derivation of digital cartographic models out of digital landscape models is reviewed. A method of symbolizing vector data by means of raster data processing is demonstrated. After a vector to raster conversion different circle templates produce different linear symbols based on a special raster data structure. An example illustrates the practicability of the method that also includes the possibility to erase parts of lines in case of overpasses on highways. ESA

N88-23285# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTER BASED MODELING OF THEMATIC MAPPING
Juergen Bollmann *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 71-81 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

A program system (modMAP-system) for the modeling of thematic maps in the process of map production is described. The modMAP-system supports the cartographer by translating spatial data into standardized map objects as well as by controlling and checking object-sign references and concrete map patterns respectively. ESA

N88-23286# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE INTEGRATION OF DIGITAL MAPS IN VEHICLE NAVIGATION SYSTEMS **c04**
Werner Lichtner *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 83-92 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Map-matching and non map-matching navigation systems are introduced. A map-matching system for motorists which needs digital data of the road-network is presented. Digitization of topographic maps, practical map scales, structuring of the data and storage problems are discussed. With the aid of the communication system driver put in the destination. The actual location of the automobile is always present even during parking. Location and route-search systems provide the navigation system input. The on-board computer processes the inputs, calculates an optimal route, and prepares a step-by-step route guidance. The communication system presents this information by a synthetic voice to the driver. The driver can ignore the guidance of the system and make his own decision. The system recognizes this fact and calculates a new optimal route to the destination immediately. It is an autonomous system but it is open to support from an infrastructure including radio beacon or satellite systems. ESA

N88-23287# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
EXTRACTION OF TEXTS AND SYMBOLS FROM UNSTRUCTURED VECTOR DATA

Andreas Illert and Jun Yang *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 93-100 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Automatic digitization of large-scale maps, especially cadastral maps is outlined. Data processing starts with scanning of original maps. Binarization and raster-to-vector conversion lead to unstructured vector data. The data is structured by pattern recognition. Classification is done in a hierarchic way starting with primitive objects like symbols and letters. Before these objects can be supplied to a recognition system they have to be separated from the rest of the data. The segmentation process is explained. Success rate of segmentation of text and symbols is 90 to 95 percent. ESA

N88-23288# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
MASS DIGITIZATION OF TOPOGRAPHIC-CARTOGRAPHIC INFORMATION
Wigand Weber *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 101-122 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Mass digitization in mapping, namely first examples, the different logical levels, the sources of information, the logical data model and its importance, automated procedures, necessary editing functions, data volumes, speed and costs of the capture process, data quality, and management aspects are reviewed. Literature about this subject is surveyed. ESA

N88-23289# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTER-ASSISTED CARTOGRAPHY RESEARCH AND DEVELOPMENT REPORT OF THE FEDERAL REPUBLIC OF GERMANY 1984 - 1986
Wigand Weber *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 123-138 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Cartographic automation systems, manual and automatic digitization, pattern recognition, data bases and information systems, standards, digital terrain models, generalization, and data manipulation, including major management decisions are reviewed. ESA

N88-23290# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
DEVELOPMENTS IN THE DESIGN OF TOPOGRAPHIC MAPS IN THE FEDERAL REPUBLIC OF GERMANY: ACTIVITIES AND SUGGESTIONS
Dieter Schmid *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 139-164 Revised (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Content, user requirements and presentation of topographic maps were examined, and improvements derived. Title design and a uniform folding pattern aims at improving presentation and use, but they require a change of format of the folded map and a change in the layout of the legend. The use of additional colors aims at improving the legibility of the maps. For the predominantly used series at 1:50,000, a color separation for planimetry and lettering was recommended as well as the introduction of new colors for road fill, residential areas, industrial areas, moorland, and heather. These improvements will be realized in the course of map revision. For the series 1:100,000 a transition is planned for the representation of settlements, introducing area tints instead of single house symbols. However, the transformation of this series require a longer period. A digital map is discussed. ESA

N88-23291# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE ATLAS OF REGIONAL DEVELOPMENT
Klaus Schliebe *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 165-172 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

The Atlas of Regional Development of the Federal Republic of Germany analyzes a large scope of topics that influence the essential conditions of life during the late seventies and the early eighties. The topics include private and public infrastructure facilities as basic conditions for regional development. Investments themselves influence the distribution of population, and consequently of housing facilities. The regional pattern makes certain claims on the landscape in which natural resources take priority. The last topics demonstrate the disparities of life in different types of regions and exemplify effects of regional policy. ESA

N88-23292# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
DOWN-TO-EARTH APPROACH FOR FINAL PROJECTS IN KARLSRUHE (FEDERAL REPUBLIC OF GERMANY)
Christian Herrmann *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 173-182 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Education in cartography, particularly student theses, is described. Projects include analysis of Bertin's (1974, 1982) graphic system and utilization of Frisby's (1983) research on processing of visual information by the eye and the brain. Maps and software for practical use are produced. ESA

N88-23293# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE REPRESENTATION OF THE SEA-BOTTOM IN DEEP SEA AREAS BY THE DIGITAL TERRAIN MODEL (DTM) PROGRAM TASH **c48**
Hinrich Claussen *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 183-191 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

A program developed for topography was adapted to bathmetry data acquired by a multibeam echo sounder. Program structure and data processing are described. An example illustrates the bathymetric practicality and economic advantages of the system. ESA

N88-23294# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTER ASSISTED GENERALIZATION OF BUILDINGS FOR DIGITAL LANDSCAPE MODELS BY CLASSIFICATION METHODS
Uwe Meyer *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 193-200 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Computer-assisted generalization of buildings for the construction of Digital Landscape Models (DLM) in the scope of a cartographic information system is discussed. Tools for the computer-assisted generalization as well as a method for typification of buildings are presented. By means of building class catalog all objects are classified by a template-matching procedure and associated to the DLM. ESA

N88-23295# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THAILAND IN MAPS. APPLICATION OF THE MAPPING SYSTEM THEMAK2 FOR SPECIFIC PURPOSE ATLAS PREPARATION
Juergen Bollmann, Markus Breithaupt, Werner Dransch, and Ulrich Freitag *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 201-211 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Maps of population and agriculture of Thailand were prepared as parts of an atlas of regional and national economic planning. The major tasks of such an atlas, the development of the concept

of computer-assisted mapping by the THEMAK2 mapping system and the results of the application of this mapping system to the data and task are described. For methodological reasons the map series starts with the elementary constructions of geobase features and ends with complex constructions of multilayered statistical maps. It proves that THEMAK2 is a useful tool for transforming rapidly census data into maps of tool for regional and national planning. ESA

N88-23296# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
MAPS FOR TOURISTS. A SYSTEMATIC APPROACH TO TOURIST CARTOGRAPHY
Ulrich Freitag *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 213-219 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Tourism is analyzed as a space oriented economy. This economic activity is the base to develop a system of functional map types. They can be grouped into: maps which offer tourist services; maps which show the routes to tourist destinations; maps which are essential tools of orientation in tourist districts; maps which serve the registration and planning of tourist services. The cartography of tourism developes in the tension between advertising and objective accuracy. ESA

N88-23297# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
URBAN CARTOGRAPHY: A BOOK REVIEW
Hans-Friedrich Gorki and Heinz Pape *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 221-227 Original contains color illustrations (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Gorki and Pape's (1987) book on urban cartography is described. The book is in German and covers mainly West Germany, but characteristics specific to other industrial countries are also dealt with. The large number of illustrations makes it useful for non German speaking cartographers. ESA

N88-23298# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
MAPS FOR THE BLIND AND METHODS OF THEIR PRODUCTION
Edwin Podschadli *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 229-244 (For primary document see N88-23279 16-43)
Avail: NTIS HC A11/MF A01

Alphabets, teaching aids, and maps for the blind are reviewed. Thermoplastic, silk screen printing, and stereo copying methods of tactile map production are described. ESA

N88-23299# Centre National d'Etudes Spatiales, Toulouse (France). Centre Spatial.
EXTENSION OF THE VEGETATION MISSION TO THERMAL INFRARED SPECTRAL BANDS [EXTENSION VERS L INFRAROUGE THERMIQUE DE LA MISSION VEGETATION, ETUDE OPTIQUE]
G. Chalon 25 Sep. 1986 43 p In FRENCH; ENGLISH summary
(CNES-T-86/224-CT/DRT/TIT/IO; ETN-88-92023) Avail: NTIS HC A03/MF A01

Two optical concepts are proposed to extend the vegetation mission to thermal infrared spectral bands. The first is a push-broom with infrared linear detector arrays and a closed cycle cryogenic refrigerator. The second is a mechanical scanner. The performance are calculated and the mass, sizes, electrical power, and technical feasibility are estimated. A detailed list of relative performance is presented. ESA

N88-23300# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
PROPOSALS FOR THE PRE-OPERATIONAL USE OF DATA FROM THE EUROPEAN REMOTE SENSING SATELLITE ERS-1 [VOORSTEL VOOR HET PRE-OPERATIONELE GEBRUIK VAN ERS-1 GEGEVENS]
J. Reiff (Royal Netherlands Meteorological Inst., De Bilt.) 1986 57 p In DUTCH
(BCRS-86-02; ETN-88-91549) Avail: NTIS HC A04/MF A01

Payload and time planning of ERS-1, and comparable satellites are discussed. The deduction of geophysical parameters from ERS-1 data is explained. The international data flow and data management, data management in the Netherlands, and mission operations plan are outlined. Finance, national and international cooperation, and commercialization possibilities are discussed. ESA

N88-23301# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
THE RADIOMETRIC PROCESSING OF SLAR MEASURING VALUES USING THE PARES PROGRAM [DE RADIOMETRISCHE BEWERKINGEN OP SLAR MEETWAARDEN DOOR HET PARES PROGRAMMA]
H. Pouwels (National Aerospace Lab., Amsterdam, Netherlands) Aug. 1986 15 p In DUTCH
(BCRS-86-04; ETN-88-91551) Avail: NTIS HC A03/MF A01

The radiometric processing of calibration measurements using the Preprocessing Airborne Remote Sensing (PARES) program is described. The internal single-point calibration pulse with which the digital side-looking radar (SLAR) is equipped, is described. The demodulation and digitizing of the radar output are explained. The PARES program is described. The global effect of the different losses is determined using an external calibration. An absolute level can be assigned to the preprocessed images. ESA

N88-23302# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
INVESTIGATION OF THE USEFULNESS OF SPECKLE ANALYSIS IN IMAGING RADAR SYSTEMS [ONDERZOEK NAAR DE BRUIKBAARHEID VAN SPECKLE-ANALYSIS IN BEELDVORMENDE RADARSYSTEMEN]
A. H. J. M. Pellemans (Technische Hogeschool, Delft, Netherlands) Oct. 1986 72 p In DUTCH
(BCRS-86-05; ETN-88-91552) Avail: NTIS HC A04/MF A01

The usefulness of speckle analysis in imaging side looking airborne radar systems was investigated. The speckle-analysis model, and the programs developed for simulations are explained. The imaging of periodic objects is presented. If the object consists of a grid of equidistant point targets, it is possible to determine periodicities in the object with repetition distances smaller than the resolution using the power density spectrum in the azimuthal direction. The model cannot be applied for sea wave observation. Decorrelation calculations give a decorrelation distance of 0.5 to 0.6 m above sea, which is smaller than half the antenna length (1.25 m). ESA

N88-23303# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
TURBIDITY PATTERNS IN THE DELTA WATERS OF SOUTHWEST NETHERLANDS ON THEMATIC MAPPER (TM) AND MULTISPECTRAL SCANNER (MSS) SATELLITE IMAGES [TROEBELHEIDSPATRONEN IN DE DELTAWATEREN VAN ZW NEDERLAND OP TM EN MSS SATELLIETBEELDEN]
J. Stronkhorst 1986 26 p In DUTCH
(BCRS-86-06; GWWS-405; ETN-88-91553) Avail: NTIS HC A03/MF A01

Operational water quality measuring using LANDSAT Thematic Mapper (TM) and Multispectral Scanner (MS) is discussed. Image processing using the Remote Sensing Data processing system RESEDA is presented. The turbidity pattern in the Fore-delta, the Eastern Scheldt and the Western Scheldt (Netherlands) are discussed. The results show the limitations of LANDSAT that was designed for remote sensing of land, for water quality control in

the delta waters with respect to spectral, radiometric, as well as spatial resolution. For the time being LANDSAT TM and MSS cannot be used for an operational water quality measuring system. ESA

N88-23304# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
RESULTS OF THE TESTING OF THE SEGMENTATION PROGRAM ON RESEDA [RESULTATEN VAN DE BEPROEVING VAN HET SEGMENTATIEPROGRAMMA OP RESEDA]
G. J. L. Nooren (National Aerospace Lab., Amsterdam, Netherlands) and D. H. Hoekman 1987 38 p In DUTCH
(BCRS-87-01; NLR-TR-86104-L; ETN-88-91554) Avail: NTIS HC A03/MF A01

A segmentation program was tested using images of agriculture and forestry areas from side looking airborne radar as well as from Seasat synthetic aperture radar. Segmentation following the method of Gerbrands, and the implementation of the segmentation algorithm in the Remote Sensing Data processing system RESEDA are explained. The experiments show that the accuracy of surface determination and field average estimate is determined by the segmentation without postprocessing. The (positive) effect of the segmentation on the classification is determined. ESA

N88-23305# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
THE USE OF LANDSAT-TM PICTURES FOR THE DETECTION OF SPACE-LIMITING ELEMENTS FOR THE BENEFIT OF LANDSCAPE PHOTOMAPPING [HET GEBRUIK VAN LANDSAT-TM OPNAMEN VOOR DETECTIE VAN RUIMTEBEGRENZENDE ELEMENTEN TEN BEHOEVE VAN LANDSCHAPSBEELDKARTERING]
F. B. vanderLaan, W. Verhoef (National Aerospace Lab., Amsterdam, Netherlands), J. Stolp, and A. A. deVeer 1987 46 p In DUTCH
(BCRS-87-02; NLR-TR-86096-L; ETN-88-91555) Avail: NTIS HC A03/MF A01

The possibility of periodically updating the inventory scale of the landscape using Thematic Mapper (TM) data of the LANDSAT satellite was investigated. For four test areas the classified data of the project Scale of the Landscape were compared with classified pixel values from the TM pictures. With respect to an adaptation of the inventory the results show that, if the present set of definitions is maintained, a visual-manual procedure is to be prefered; if a fully automated treatment is chosen, a procedure as used in the project can be applied. In both cases the pictures from SPOT satellite have to be prefered to the TM pictures. ESA

N88-23306# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
USERS GUIDE TO CAESAR
H. Pouwels (National Aerospace Lab., Amsterdam, Netherlands) 1987 31 p
(BCRS-87-04; NLR-Memo-IE-87-012-U; ETN-88-91557) Avail: NTIS HC A03/MF A01

The user guide to the charge coupled device (CCD) Airborne Experimental Scanner for Applications in Remote Sensing (CAESAR), containing spectral, radiometric and geometric specifications, is presented. The architecture and construction of CAESAR are described. The spectral, radiometric and geometric specifications of the different modes of the CAESAR CCD scanner are outlined. The quick-look nonprocessed image, and the preprocessing via optical pairs are presented. All relevant parameters are given in an extensive table. A set of specification forms is designed to facilitate the definition of test flights. ESA

N88-23307# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
PREPARATION OF THE OPERATIONAL PHASE OF THE EUROPEAN REMOTE SENSING SATELLITE ERS-1 [VOORBEREIDINGEN OP DE OPERATIONELE FASE VAN ERS-1]
J. Reiff (Royal Netherlands Meteorological Inst., De Bilt.) Jul. 1987 23 p In DUTCH
(BCRS-87-06; ETN-88-91558) Avail: NTIS HC A03/MF A01

The coordination of the announcement of opportunity, the mission operation plan, and the possible Dutch contribution to the calibration and validation of ERS-1 are discussed. The study of the Dutch proposals to the announcement of opportunity for ERS-1 shows that the coordination of the needs for ERS-1 synthetic aperture radar images by ESA is desired. With respect to the mission operation plan it is important for the Netherlands that the operational wind and wave data are available within 1 to 2 hr, and that sufficient radar images of the Dutch coast are available. The development of a C-band SAR, as a contribution to the ERS-1 validation program, is discussed. ESA

N88-23308# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
LIGHT SCATTERING OF INTRACELLULAR GAS VACUOLES: ANOMALOUS BEHAVIOR OF FORWARD AND PERPENDICULAR LIGHT SCATTERING OF A CYANOBACTERIUM DUE TO INTRACELLULAR GAS VACUOLES
Marcel Donze, George B. J. Dubelaar, and Jan W. M. Visser (Radiobiological Inst. TNO, Rijswijk, Netherlands) Jul. 1987 26 p
(BCRS-87-08; ETN-88-91559) Avail: NTIS HC A03/MF A01

Light scattering, chlorophyll fluorescence, and light absorption of the blue-green algae microcystis aeruginosa were determined as a function of their amount of gas vacuoles. Flow cytometry shows that the presence of gas vacuoles causes a tenfold increase in perpendicular light scatter, and a fivefold decrease in forward light scatter. Chlorophyll fluorescence shows a 16 percent decrease; the size of the algae is not affected. The absorption spectrum of microcystis aeruginosa is slightly raised, but practically not distorted by the gas vacuoles. The attenuation spectrum, a measure for light extinction by the algal cells, is significantly distorted. The increase of perpendicular light scatter intensity of the cells is a direct consequence of the relatively high scatter of each vacuole, whereas the forward light scatter decrease is attributed to a lower phase shift factor of the whole cells, due to the intact gas vacuoles. ESA

N88-23309# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
STUDY OF THE PLAN FOR A NATIONAL DATA CENTER FOR THE EUROPEAN REMOTE SENSING SATELLITE ERS-1 [STUDIE NAAR DE OPZET VAN EEN NATIONAAL ERS-1 DATACENTRUM]
R. W. vanSwol (National Aerospace Lab., Amsterdam, Netherlands) Jul. 1987 80 p In Dutch
(BCRS-87-11; NLR-TR-87055-L; ETN-88-91560) Avail: NTIS HC A05/MF A01

The way to receive and distribute in the Netherlands the data of ERS-1 was studied. It was investigated which data will come from ERS-1, which data products will be deduced by ESA, how ESA will distribute these products, and who will be the Dutch users. The investigation shows that for the Netherlands the real-time use of ERS-1 data in regional weather and wave prediction models will be the most important operational application of the data. In that respect, proposals for the practical use of the data are given. ESA

N88-23310# Begeleidingscommissie Remote Sensing, Delft (Netherlands).
INTERNATIONAL COMMERCIALIZATION OF REMOTE SENSING Interim Report [INTERNATIONALE COMMERCIALISERING REMOTE SENSING]

Jul. 1987 63 p In DUTCH Prepared in cooperation with EUROCONSULT B.V., Arnhem, The Netherlands and DHV Raadgevend Ingenieursbureau B.V., Amersfoort, The Netherlands
(BCRS-87-14; ETN-88-91561) Avail: NTIS HC A04/MF A01

The results of Dutch remote sensing research were inventoried and analyzed with a view to commercial applications. Criteria for the commercialization of products are outlined. The analysis shows that if these criteria are strictly applied to the available products of Dutch remote sensing research, only a very low percentage of these products is suitable for commercialization. The available expertise is valuable for the development of the operational use of remote sensing for well described applications. ESA

N88-23311# Begeleidingscommissie Remote Sensing, Delft (Netherlands). Programmabureau.
THE MULTIANNUAL NATIONAL REMOTE SENSING PROGRAM (NRSP) [MEERJARENPROGRAMMA NRSP]
N. J. J. Bunnik Aug. 1987 28 p In DUTCH
(BCRS-87-16; ETN-88-91562) Avail: NTIS HC A03/MF A01

Remote sensing applications on land and water, and commercialization are outlined. Technological development in microwave sensors, optical sensors, and data processing are discussed. The infrastructure is outlined. ESA

N88-23312# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
A STUDY ON LOCAL LEVEL INERTIAL SURVEYING SYSTEMS. ERROR MODEL FOR THE STATIONARY SYSTEM Thesis
B. J. Hulshof May 1987 72 p
(B8736714; ETN-88-92425) Avail: NTIS HC A04/MF A01

Error propagation and its influence on the adjustment procedure in local level inertial surveying systems are treated. The derivation of the dynamic matrix, transition matrix approaches, error propagation calculation, and solution of the initial state vector are covered. ESA

N88-23313# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
SATELLITE GRADIOMETRY Thesis
R. Koop Feb. 1987 98 p
(B8735057; ETN-88-92426) Avail: NTIS HC A05/MF A01

The satellite gradiometry measuring process is analyzed according to Baarda's theory of experimental limit process which links mathematical and stochastic models to the measuring procedure. It is not clear if Baarda's ideas are applicable. The order of magnitude of gravity gradients was studied using covariance functions. Results suggest that for altitudes higher than 160 km the measurement signal is large enough to be detectable and discriminated from noise. ESA

N88-23314* National Aeronautics and Space Administration, Washington, D.C.
EARTH RESOURCES: A CONTINUING BIBLIOGRAPHY WITH INDEXES (ISSUE 57)
May 1988 129 p
(NASA-SP-7041(57); NAS 1.21:7041(57)) Avail: NTIS HC A07 CSCL 08B

This bibliography lists 451 reports, articles and other documents introduced into the NASA scientific and technical information system between January 1 and March 31, 1988. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N88-23315# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
USE OF ENERGY EMISSION FOR DETECTING THE NECESSITY OF IRRIGATION IN WHEAT IN FIELD CONDITIONS M.S. Thesis [USO DE ENERGIA EMITIDA, PARA DETECTAR NE CESSIDADE DE IRRIGACAO EM TRIGO, EM CONDICOES DE CERRADO]
Rubens Augusto CamargoLamparelli Apr. 1988 99 p In PORTUGUESE; ENGLISH summary
(INPE-4461-TDL/318) Avail: NTIS HC A05/MF A01

Through the utilization of plant parameters (radiometric canopy temperature, T sub d, aerodynamic and canopy resistances) and meteorological data (air temperature, T sub A, global net radiation, R sub n, vapor pressure deficit in air, delta e), which are components of the Index (CWSI), the utility of this methodology is demonstrated to identify the plant water status and detect irrigation necessity. The objectives of this methodology were to: observe the T sub d behavior with irrigation levels; verify cloud and wind influences in the T sub d; and to observe the index (CWSI) behavior, as an indicative irrigation necessity. That experiment was performed in the Centro de Pesquisas Agropecuarias dos Cerrados (CPAC) and consists of three parcels with the following treatments: daily irrigation; irrigation (day 50 after the seedling growth); two irrigations (days 50 and 60 after seedling growth), in the booting period. At thirty-day intervals, T sub A, T sub d, R sub n, wind velocity, soil water potential data and plant parameters were collected daily. The results showed that the radiometric canopy temperature and the index (CWSI) had a relationship according to the treatments verified through the data. The wind influence was only observed in radiometric canopy temperature and cloud appearance provoked changes in the radiometric canopy temperature as well as in the index (CWSI). The qualitative analysis was possible only because of the small sensibility of some systems of measurement.
Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-23316# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
VARIABLE SPEED OPTIMAL CONTROL OF A WIND TURBINE GENERATOR Ph.D. Thesis - Paul Sabatier Univ.
Laurent Marechal (Ecole Nationale Superieure de Techniques Avancees, Paris, France) 1987 116 p In FRENCH; ENGLISH summary Sponsored by the Agence Francaise pour la Maitrise de l'Energie, France
(LAAS-87-358; ETN-88-92010) Avail: NTIS HC A06/MF A01

The control of the resistant torque of a wind generator was investigated in order to track the rotor optimal tip speed ratio while minimizing the strains in the drive torque. For the case of steady winds, a controller is determined and analyzed by simultaneously using selected design characteristics, including the diagonal weighting parameters of a quadratic index, the eigenvalues and the state feedback coefficients. For the case of nonsteady windspeeds, further requirements are introduced to construct a controller with constant feedback, for which stability and convergence to the optimal state are checked. ESA

N88-23317# Giner, Inc., Waltham, Mass.
ELECTROCHEMICAL HYDROGEN CONCENTRATOR FOR PHOSPHORIC ACID FUEL CELLS Final Report, 30 Sep. 1986 - 30 Sep. 1987
Jose Giner and Nancy D. Kackley Nov. 1987 36 p

(Contract DAAK70-86-C-0114)
(AD-A191355; C86-14) Avail: NTIS HC A03/MF A01 CSCL 21D

The production of high purity hydrogen for use in phosphoric acid fuel cell from heavily contaminated reformed diesel fuel gas using an electrochemical device has been demonstrated. The electrochemical hydrogen separator (EHS) is based on current PAFC technology. Hydrogen is removed from the contaminated gas stream by oxidation to hydrogen ions at a gas diffusion cathode. An anode catalyst with excellent tolerance to high levels of CO and H2S contaminants has been developed. The use of this anode catalyst would allow the EHS device to produce pure hydrogen with minimal voltage impact on the overall PAFC power output. Reduction in size and weight of the PAFC power plant is also indicated through reduced load on fuel processing components. GRA

N88-23318# Giner, Inc., Waltham, Mass.
COMPACT REGENERABLE SULFUR SCRUBBER FOR PHOSPHORIC ACID FUEL CELLS Final Report, 30 Sep. 1986 - 30 Sep. 1987
Jose Giner and Cecelia C. Cropley 30 Nov. 1987 48 p
(Contract DAAK70-86-C-0113)
(AD-A191356; C86-12) Avail: NTIS HC A03/MF A01 CSCL 10C

Technology for the direct desulfurization of unprocessed diesel fuel using regenerable copper-based mixed metal oxide sorbents was developed for incorporation in modular phosphoric acid fuel cell (PAFC) generators. Removal of greater than 60 percent of the sulfur in diesel fuel was demonstrated, and sorbent sulfur loadings of approximately 1 wt percent were attained. Preliminary studies indicated that the sorbents are regenerable, with up to 70 percent of the sorbed sulfur removed during regeneration. Incorporation of this technology into a PAFC power plant should reduce the weight of the sulfur removal unit by a minimum of 25 percent. GRA

N88-23319# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
NICKEL HYDROXIDE ACTIVE MATERIAL DENSITIES
A. H. Zimmerman and P. K. Effa 5 Feb. 1988 44 p
(AD-A191411; TR-0086A(2945-01)-3; SD-TR-88-02) Avail: NTIS HC A03/MF A01 CSCL 10C

The density of nickel electrode active materials was measured in situ as a function of the state of charge and operating conditions of the nickel electrode. Sintered electrodes made by both chemical and electrochemical impregnation methods were studied, and the effects of cobalt additives on the density and compressibility of the active material determined. The results clearly indicate a phase transition that occurs when the active material is charged above an oxidation state of about 2.7. The transition involves large changes in the density, volume, and compressibility of the active material. Changes in density during open circuit stand, cycling, and trickle charging were measured and the results correlated with the operating characteristics of nickel electrodes in battery cells. GRA

N88-23021# Joint Publications Research Service, Arlington, Va.
SUNSHINE PROJECT FOR FY 1987 OUTLINED
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 16-28 Transl. into ENGLISH from Jita Nyusu (Tokyo, Japan), Apr. 1987 p 5-10 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

N88-23594# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
DIFFERENTIAL SPECTRAL RADIOMETRY [DIFFERENTIELLE SPEKTRALRADIOMETRIE]
J. Metzdorf, H.-C. Holstenberg, and H. Kaase *In its* Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 142-162 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-23320# Royal Netherlands Meteorological Inst., De Bilt. Physical Meteorology Dept.
THE SPREADING AND MIXING OF DENSE GAS CLOUDS IN STILL AIR Ph.D. Thesis - Technische Hogeschool
A. P. vanUlden 1987 106 p
(KNMI-WR-87-12; ISSN-0169-1651; B8801241; ETN-88-92480)
Copyright Avail: NTIS HC A06/MF A01

A model of dense gas clouds, such as chlorine, in the phase where gravity induced spreading and mixing dominates dispersion, was derived. From the fundamental equations of motions, integral equations for the spreading, slumping, and mixing of the cloud are derived. These equations account for radial and vertical accelerations in and around the cloud and for the effect of large density differences between the cloud and the environment. Turbulent mixing is described with an entrainment equation, which uses the turbulent kinetic energy of the cloud. This turbulent energy is described with a time-dependent turbulent-energy equation. The model is compared with observations on axisymmetric dense clouds from the literature. For radial gravity spreading agreement between model simulations and experimental data is satisfactory. Analysis shows that near-surface concentrations are likely to be much higher than indicated by previous studies of the same experimental data. The reason for this is that usually a Gaussian or uniform profile is assumed for the vertical distribution of area-averaged cloud concentrations. However, such profiles are poor approximations to the observed profiles, especially close to the ground where strong vertical gradients are observed. A new ad-hoc similarity profile is proposed, and gives a satisfactory simulation of observed concentrations. ESA

N88-23321# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
GEOCHEMISTRY OF THE MIDDLE AND LOWER ATMOSPHERE: ENVIRONMENTAL IMPACT THROUGH THE DETERIORATION OF THE OZONE LAYER [GEOQUIMICA DA MEDIA E BAIXA ATMOSFERA: IMPACTOS AMBIENTAIS POR DETERIORACAO DA CAMADA DE OZONIO]
V. W. J. H. Kirchhoff Feb. 1988 24 p In PORTUGUESE; ENGLISH summary Presented at the 1st Brazilian Conference on Geochemistry, Porto Alegre, Brazil, 30 Oct. - 2 Nov. 1987
(Contract FINEP-537/CT)
(INPE-4477-PRE/1241) Avail: NTIS HC A03/MF A01

Atmospheric ozone is discussed in view of recent concerns about the ozone layer. Emphasized are the atmosphere, its chemical composition, the definition of its ozone layer, and the latter's possible destruction. Even the partial destruction of the ozone layer would have disastrous consequences, i.e., increased skin cancer, the effect on microorganisms, the greenhouse effect, and damage to forests. The objective of this study is to share these concerns with the world community and stimulate other studies and research in this area of Geochemistry. Author

N88-23322# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DETECTION, MONITORING AND ANALYSIS OF SOME ENVIRONMENTAL EFFECTS OF FIRES IN THE AMAZON REGION THROUGH UTILIZATION OF NOAA AND LANDSAT SATELLITE IMAGERY AND AIRCRAFT DATA M.S. Thesis [DETECCAO, MONITORAMENTO E ANALISE DE ALGUNS EFEITOS AMBIENTAIS DE QUEIMADAS NA AMAZONIA ATRAVES DA UTILIZACAO DE IMAGENS DOS SATELITES NOAA E LANDSAT, E DADOS DE AERONAVE]
Marcos daCostaPereira 1987 258 p In PORTUGUESE;

ENGLISH summary
(INPE-4503-TDL/326) Avail: NTIS HC A12/MF A01

The purpose is to analyze, using orbital remote sensing as a main tool, some of the environment effects caused by combustion of large amounts of biomass in the Amazon forest. During the GTE/ABLE-2A, an experiment to measure trace gases and aerosols in the Amazon troposphere from July 19 to August 8, 1985, twenty-five images of the NOAA-8 and 9 satellites were recorded, in which many smoke plumes and fires of large dimensions were detected. After locating the areas most affected by the fires, LANDSAT/TM images of the same place were processed and the spectral characteristics of the fires and burned sites were studied with both satellites. With radiosounding data a trajectory analysis of the emissions were performed in order to study the long-range transport of pollutants. Based on aircraft sampling data from GTE/ABLE-2A an estimate was performed of the amounts of gases and aerosols produced by regional and global effects. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-23323# Bhabha Atomic Research Centre, Bombay (India).
RESEARCH AND DEVELOPMENT ACTIVITIES OF THE SEISMOLOGY SECTION Report, Jan. 1984 - Dec. 1985
C. A. Krishnan, ed. and G. S. Murty, ed. 1987 83 p
(DE88-701235; BARC-1350) Avail: NTIS (US Sales Only) HC A05/MF A01

The Research and Development (R and D) activities during 1984 to 1985 of the Seismology Section of the Bhabha Atomic Research Centre, Bombay, are reported in the form of individual summaries. The R and D activities of the section are directed towards development of seismological instruments and methods of analysis of the seismic field data with the main objective of detecting underground nuclear explosions and assessing seismicity and seismic risk of sites considered for nuclear power stations. The section has two field stations, one at Gauribidanur in the southern part of the country and another at Delhi i.e., in the northern part of the country. During the report period, a total of 62 events out of the detected ones were identified as underground explosions. The expertise of the section is also made available for outside organizations. DOE

N88-23324# California Univ., Berkeley. Lawrence Berkeley Lab.
A THREE-DIMENSIONAL GRAVITY MODEL OF THE GEOLOGIC STRUCTURE OF LONG VALLEY CALDERA
S. F. Carle and N. E. Goldstein Mar. 1987 15 p Presented at the Symposium on the Long Valley Caldera: Pre-drilling Data Review, Berkeley, Calif., 17 Mar. 1987
(Contract DE-AC03-76SF-00098)
(DE88-006331; LBL-24572; CONF-8703199-2) Avail: NTIS HC A03/MF A01

Several attempts to define and interpret this anomaly have been made in the past using 2-D and 3-D models. None of the previous interpretations have yielded definitive results, but in fairness, the interpretation here has benefited from a larger gravity data base and more subsurface control than available to previous workers. All published 3-D models simplistically assumed constant density of fill. All 2-D models suffered from the inherent three-dimensionality of the complicated density structure of Long Valley caldera. In addition, previous interpreters have lacked access to geological data, such as well lithologies and density logs, seismic refraction interpretations, suface geology, and structural geology interpretations. The purpose of this study is to use all available gravity data and geological information to constrain a multi-unit, 3-D density model based on the geology of Long Valley caldera and its vicinity. Insights on the geologic structure of the caldera fill can help other geophysical interpretations in determining near-surface effects so that deeper structure may be resolved. With adequate control on the structure of the caldera fill, we are able to examine the gravity data for the presence of deeper density anomalies in the crust. DOE

N88-23325# California Univ., Berkeley. Lawrence Berkeley Lab.
A CORE HOLE INTO THE HYDROTHERMAL SYSTEM OF THE LONG VALLEY CALDERA
H. Wollenberg, A. White, S. Flexser, M. Sorey, and C. Farrar Mar. 1987 4 p Presented at the Symposium on the Long Valley Caldera: Pre-Drilling Data Review, Berkeley, Calif., 17 Mar. 1987 Prepared in cooperation with Geological Survey, Menlo Park, Calif. and Geological Survey, Santa Rosa, Calif.
(Contract DE-AC03-76SF-00098)
(DE88-006335; LBL-24569; CONF-8703199-1) Avail: NTIS HC A02/MF A01

To investigate the present-day hydrothermal system, the Shady Rest hole was continuously cored 715m into the southwestern moat of the Long Valley caldera. The hole intersected 100m of glacial till and 300m of postcaldera rhyolite before entering the welded Bishop Tuff and bottoming in that unit. A sharp temperature rise over the upper 350m, and near-isothermal conditions below reflect the presence of approx.200°C water moving through open, calcite-lined fractures in silicified Early Rhyolite and Bishop Tuff. The depth to the Bishop is the shallowest encountered in holes in the caldera, and the temperatures measured are among the hottest observed in wells drilled within the caldera. DOE

N88-23326# Swedish Inst. of Space Physics, Kiruna.
SIMULTANEOUS OBSERVATION OF UPWARD MOVING FIELD ALIGNED ENERGETIC ELECTRONS AND IONS ON AURORAL ZONE FIELD LINES
B. Hultqvist, R. Lundin, K. Stasiewicz, L. Block, P.-A. Lindqvist, G. Gustafsson, H. Koskinen, A. Bahnsen, T. A. Potemra, and L. J. Zanetti (Johns Hopkins Univ., Laurel, Md.) Nov. 1987 32 p
(IRF-Preprint-102; ISSN-0284-1711; ETN-88-92196) Avail: NTIS HC A03/MF A01

Swedish Viking satellite observations of energetic electrons and ions which move upward along the magnetic field lines with energies of the same order or magnitude are presented. The field aligned particles are associated with a strong broadbanded low frequency turbulence in the electric field and with downward Birkeland currents. It is suggested that ions and electrons are accelerated by time-varying field-aligned electric fields. The downward field component accelerating the electrons upward is experienced as quasistatic by the electrons while they remain in the height-limited acceleration region, but not by the ions. ESA

N88-23327# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
A PROPOSAL FOR THE ESTABLISHMENT OF A CENTER OF EXCELLENCE IN THEORETICAL GEOPLASMA RESEARCH Annual Report, 1 Oct. 1986 - 30 Sep. 1987
Tom Chang 1987 59 p
(Contract F49620-86-C-0128; AF Proj. 3484)
(AD-A189742; AFOSR-87-1882TR) Avail: NTIS HC A04/MF A01 CSCL 04A

A detailed description of the activities, accomplishments, and research progress of the Center for Theoretical Geoplasma Physics are contained. Much was accomplished in the past twelve months. Research topics considered include: ionosphere-magnetosphere coupling, high-latitude ionospheric turbulence, charged particle acceleration and heating, nonclassical polar wind, double layers, magnetic reconnection, strong MHD turbulence, plasma radiations induced by moving conducting objects in the low-altitude ionosphere, and F-region subvisual polar arcs. Author

N88-23328# Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Physics and Engineering Lab.
OZONESONDE OBSERVATIONS AT LAUDER, NEW ZEALAND DURING THE SPRING AND EARLY SUMMER OF 1986 Final Report
W. A. Matthews, W. D. Komhyr, and P. R. Franchois Oct. 1987 161 p Prepared in cooperation with NOAA, Boulder, Colo. and Colorado Univ., Boulder
(PB88-173273; PEL-R-960) Avail: NTIS HC A08/MF A01 CSCL 04A

Atmospheric ozone vertical distributions and air temperature profiles are presented for Lauder, New Zealand (45 deg S, 170 deg E) from 37 ECC ozone-sonde soundings made during 1 Aug. to 31 Dec. 1986. Author

N88-23329# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
BOGOLYUBOV TRANSFORMATION IN RELATIVISTIC THEORY OF GRAVITATION
V. O. Solovev and V. B. Tverskoj 1987 11 p In RUSSIAN; ENGLISH summary
(DE88-701592; IFVE-OTF-87-8) Avail: NTIS (US Sales Only) HC A03/MF A01

The gravitational field is quantized on the base of the canonical formalism of the Relativistic Theory of Gravitation by means of Bogolyubov tansformation. The translational-invariant scheme of the perturbation theory was constructed. The Hamiltonian is obtained in the zero-order over coupling constant. DOE

N88-23330*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
MODELING AND ESTIMATION OF A LOW DEGREE GEOPOTENTIAL MODEL FROM TERRESTRIAL GRAVITY DATA
Nikolaos K. Pavlis Mar. 1988 87 p
(Grant NAG5-781)
(NASA-CR-182808; NAS 1.26:182808; OSU-386) Avail: NTIS HC A05/MF A01 CSCL 08E

The development of appropriate modeling and adjustment procedures for the estimation of harmonic coefficients of the geopotential, from surface gravity data was studied, in order to provide an optimum way of utilizing the terrestrial gravity information in combination solutions currently developed at NASA/Goddard Space Flight Center, for use in the TOPEX/POSEIDON mission. The mathematical modeling was based on the fundamental boundary condition of the linearized Molodensky boundary value problem. Atmospheric and ellipsoidal corrections were applied to the surface anomalies. Terrestrial gravity solutions were found to be in good agreement with the satellite ones over areas which are well surveyed (gravimetrically), such as North America or Australia. However, systematic differences between the terrestrial only models and GEMT1, over extended regions in Africa, the Soviet Union, and China were found. In Africa, gravity anomaly differences on the order of 20 mgals and undulation differences on the order of 15 meters, over regions extending 2000 km in diameter, occur. Comparisons of the GEMT1 implied undulations with 32 well distributed Doppler derived undulations gave an RMS difference of 2.6 m, while corresponding comparison with undulations implied by the terrestrial solution gave RMS difference on the order of 15 m, which implies that the terrestrial data in that region are substantially in error. Author

N88-23331# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
IONOSPHERIC RESEARCH IN ANTARCTICA [PESQUISAS IONOSFERICAS NA ANTARTICA]
Rene A. Medrano-B. May 1988 20 p In PORTUGUESE; ENGLISH summary Presented at the 2nd Regional Meeting of Geophysics, Salvador, Brazil, 25-27 Nov. 1987
(Contract FINEP-537/CT)
(INPE-4521-PRE/1273) Avail: NTIS HC A03/MF A01

During the Antarctic Operation VI mission, to be initiated in December 1987, INPE will install scientific equipment designed to measure ionospheric absorption of cosmic noise at the Comandante Ferraz Brazilian Station (52 deg magnetic latitude, L=2.25). This equipment, consisting of three riometers with antennas pointing in three different directions, expects to determine expansion velocities of events such as the Polar Cap Absorption (PCA) due to ionization in the atmosphere by solar energetic protons, and the Auroral Absorption (AA), due to precipitation of energetic electrons from the magnetosphere during substorms. The experiment will also identify electronic structures of diameters less than 340 km, and will permit the study of the physics and chemistry of the lower ionosphere (D-layer). The working principle of riometers is described. Also, a review of the most important ionospheric events related to ionospheric absorption, showing the perspectives of research with the data to be acquired, is presented. Author

N88-23332# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE EFFECTS OF SOLAR CYCLE AND LATITUDE DEPENDENCE ON THE FORMATION OF IONOSPHERIC C LAYER M.S. Thesis [EFEITOS DO CICLO SOLAR E DEPENDENCIA LATITUDINAL NA FORMACAO DA CAMADA C IONOSFERICA]
Vera Lucia RequiaKuntz Sep. 1987 86 p In PORTUGUESE; ENGLISH summary
(INPE-4342-TDL/293) Avail: NTIS HC A05/MF A01

The C-layer effect is observed on long distance very low frequency (VLF) signal propagation at sunrise, when the solar illumination line (terminator) makes a small angle (alpha is less than 20 deg) with the propagation path. The effect may be described as an additional phase advance, just after the sunrise normal phase advance, recovering in about 90 minutes. Analysis of different propagation paths shows that the magnitude of the observed effect presents a latitudinal and solar cycle dependence. Data obtained for geomagnetic latitudes ranging 14 deg N to 50 deg S have shown that the C-layer effect seems to be more pronounced at higher latitudes. Finally analysis of data at different phases of the solar cycle suggest that for the period of maximum activity the magnitude of the observed C-layer effect is reduced. These effects may be understood bearing in mind that cosmic radiation is mainly responsible for the ionization of regions below the ionospheric D-layer. It is more intense at higher latitudes and also presents a variation with the solar cycle, being minimum when maximum solar activity occurs. In the analysis, different phenomena which could influence the C-layer effect were taken into account, such as SIDs at sunrise, Forbush decrease, stratwarm and magnetic storms. Author

N88-23333# Leicester Univ. (England). Dept. of Physics.
STUDIES OF IONOSPHERE/MAGNETOSPHERE DYNAMICS USING SABRE AND HILAT Final Report, 1 Mar. 1986 - 28 Feb. 1987
Tudor B. Jones and Jeffrey A. Waldock 20 Sep. 1987 29 p
(Grant AF-AFOSR-0077-84)
(AD-A190947; AFGL-TR-87-0273) Avail: NTIS HC A03/MF A01 CSCL 04A

Plasma drift measured by SABRE in the E-region have been compared with those obtained from HILAT, at an altitude of 800 km. Results are not consistent with perfect mapping of the electric field between the two regions. Furthermore, no field-aligned current signature is observed by SABRE. A comparison of E-region plasma drifts measured by SABRE and F-region scintillations measured by the NNSS satellites suggests that the latter may be related to regions of reduced electric field in the F-region. This is consistent with the presence of field-aligned currents which produce kilometer-scale structure in the F-region plasma. Mean plasma convection patterns in the E-region have been derived as a function of the IMF components By and Bz and the magnetic index Kp. Convection flows are much stronger for southward Bz. The time of the evening convection reversal occurs at later local times for increasingly negative By. As Kp increases radar measurements occur during a higher proportion of the day and the evening convection reversal also moves to earlier local times. GRA

N88-23334# Spectral Sciences, Inc., Burlington, Mass.
STUDY OF POLYATOMIC DYNAMICS IN THE ATMOSPHERE Final Report, 30 Dec. 1983 - 30 Jan. 1987
F. Bien, S. M. Adler-Golden, and N. M. Goldstein 25 Mar. 1987 201 p
(Contract F19628-84-C-0029)
(AD-A190964; SSSI-TR-116; AFGL-TR-87-0223) Avail: NTIS HC A10/MF A01 CSCL 04A

The purpose of this work was to study a number of infrared-active species, produced in the disturbed atmosphere, both experimentally and theoretically. These comprehensive studies will aid the interpretation of existing laboratory and field data. These studies are especially valuable because the existing data base and models were deficient in their ability to predict the highly non-thermal chemical, physical and radiative properties of the upper atmosphere, particularly under disturbed conditions. GRA

N88-23335# Naval Postgraduate School, Monterey, Calif.
UTILIZATION OF DENSE PACKED PLANAR ACOUSTIC ECHOSOUNDERS TO IDENTIFY TURBULENCE STRUCTURE IN THE LOWEST LEVELS OF THE ATMOSPHERE M.S. Thesis
Louis R. Moxcey Dec. 1987 73 p
(AD-A191006) Avail: NTIS HC A04/MF A01 CSCL 17A

Coherent light beams propagating through the atmosphere undergo considerable phase perturbations due to fluctuating temperature structures in the atmosphere. One method used to detect these temperature structures is an acoustic profiler, or echosounder. Of immediate interest is the ability of high frequency (5 kHz) planar array echosounders to rapidly detect low level turbulence (below 200 meters) and quantify the results. This thesis involves design improvements of previously developed echosounder arrays and associated software. Particularly, this thesis demonstrates that tighter packing of elements in a planar acoustic array produces better side lobe reduction than less densely packed arrays. This results in higher energy density in the main lobe and increased performance. Also included in this thesis is a computer method which allows relatively accurate beam pattern prediction from any given planar array. GRA

N88-23336# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
A PLASMA WAVE INSTRUMENT ON THE AMPTE/IRM (ACTIVE MAGNETOSPHERIC PARTICLE TRACING EXPLORERS/ION RELEASE MODULE) SPACECRAFT Final Technical Report, 1 Dec. 1981 - 31 Aug. 1987
Roger R. Anderson and Donald A. Gurnett 27 Jan. 1988 5 p
Original contains color illustrations
(Contract N00014-82-K-0183)
(AD-A191216) Avail: NTIS HC A02/MF A01 CSCL 04A

The primary purposes of the Active Magnetospheric Particle Tracing Explorers (AMPTE) program were twofold: (1) to carry out the release and monitoring of lithium and barium ions in the solar wind and the distant magnetosphere in order to study the transport of energization of magnetospheric particles, and to investigate the instabilities and wave-particle interactions associated with the releases and subsequent evolution of the injected clouds; and (2) to carry out large releases of barium in the solar wind with the objective of producing artificial comets and studying the interaction of the injected plasma clouds with the solar wind. GRA

N88-23035# Joint Publications Research Service, Arlington, Va.
PROPAGATION OF ACOUSTIC GRAVITY WAVE SPECTRUM THROUGH VERTICAL WIND SHEAR REGION Abstract Only
Fan Yi, Baixian Liang, and Jun Li *In its* JPRS Report: Science and Technology. China 3 May 1988 p 127 Transl. into ENGLISH from Diqiu Wuli Xuebao (Beijing, People's Republic of China), v. 31, no. 1, Jan. 1988 p 1-9 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-23337# Wisconsin Univ., Madison. Space Science and Engineering Center.
VALIDATE ALGORITHMS FOR THE DETERMINATION OF RAINFALL RATES FROM SSM/I MICROWAVE SATELLITE IMAGERY Progress Report, Aug. - Sep. 1987
Sep. 1987 3 p
(Contract N00014-86-C-2001)
(AD-A188769) Avail: NTIS HC A02/MF A01 CSCL 04B

This research effort has focussed on (a) obtaining and processing radar and calibrating raingage data from our primary validation sites which correspond to SSM/I overpasses, (b) ordering the SSM/I data for the same cases, and (c) completing the software required for merging the surface data and the SSM/I measurements. Since the required surface data has only recently arrived only a preliminary assessment has been made of the SSM/I brightness temperature measurements and rainfall products using National Weather Service raingage reports and GOES infrared imagery. GRA

N88-23338*# Research and Data Systems, Inc., Greenbelt, Md. RDS Airborne Antarctic Ozone Experiment Team.
NEAR-REAL-TIME TOMS, TELECOMMUNICATIONS AND METEOROLOGICAL SUPPORT FOR THE 1987 AIRBORNE ANTARCTIC OZONE EXPERIMENT
P. Ardanuy, J. Victorine, F. Sechrist, A. Feiner, and L. Penn Apr. 1988 136 p
(Contract NAS5-29373)
(NASA-CR-4133; NAS 1.26:4133; Rept-88-44) Avail: NTIS HC A07/MF A01 CSCL 04B

The goal of the 1987 Airborne Antarctic Ozone Experiment was to improve the understanding of the mechanisms involved in the formation of the Antarctic ozone hole. Total ozone data taken by the Nimbus-7 Total Ozone Mapping Spectrometer (TOMS) played a central role in the successful outcome of the experiment. During the experiment, the near-real-time TOMS total ozone observations were supplied within hours of real time to the operations center in Punta Arenas, Chile. The final report summarizes the role which Research and Data Systems (RDS) Corporation played in the support of the experiment. The RDS provided telecommunications to support the science and operations efforts for the Airborne Antarctic Ozone Experiment, and supplied near real-time weather information to ensure flight and crew safety; designed and installed the telecommunications network to link NASA-GSFC, the United Kingdom Meteorological Office (UKMO), Palmer Station, the European Center for Medium-Range Weather Forecasts (ECMWF) to the operation at Punta Arenas; engineered and installed stations and other stand-alone systems to collect data from designated low-orbiting polar satellites and beacons; provided analyses of Nimbus-7 TOMS data and backup data products to Punta Arenas; and provided synoptic meteorological data analysis and reduction. Author

N88-23339# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
NOAA-ERL-ARL (NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION-ENVIRONMENTAL RESEARCH LABORATORIES-AIR RESOURCES LABORATORY) SOLAR UV RADIATION AND CLIMATE RESEARCH PROJECT: PROGRAM DESCRIPTION Progress Report
L. C. Puga, R. F. Donnelly, J. Barrett, G. Falcon, and K. Pfendt Nov. 1987 120 p
(PB88-169396; NOAA-TM-ERL-ARL-159) Avail: NTIS HC A06/MF A01 CSCL 04B

Topics addressed include: introduction to the solar UV radiation and climate research project; studies of the modeled UV irradiance and solar indices; analysis of Nimbus-7 satellite measured UV irradiance; problems in analyses; atmospheric physics; and publications and references. GRA

N88-23340# National Center for Atmospheric Research, Boulder, Colo.
GLOBAL ATMOSPHERIC CIRCULATION STATISTICS, 1000-1 mb
W. J. Randel Dec. 1987 243 p
(Grant NSF ATM-87-09659)
(PB88-168240; NCAR/TN-295-STR) Avail: NTIS HC A11/MF A01 CSCL 04B

Daily, global geopotential height grids covering 70-1 mb, produced since 1979 by the Climate Analysis Center were combined with conventional National Meteorological Center geopotential analyses over 1000-100 mb to produce a daily data set covering the globe over 1000-1 mb for the eight years 1979-1986. The document presents monthly means, along with dialy and interannual variabilities of various circulation statistics derived from these data: zonal mean temperatures and winds, poleward heat and momentum fluxes, Eliassen-Palm flux divergences, and stationary and transient planetary wave statistics. Horizontal winds are derived from the geopotential fields via a method which gives significant improvements over local geostropic values in the stratosphere. Meridional cross sections are presented for each month, along with Northern Hemisphere and Southern Hemisphere polar stereographic projections at various pressure levels for January, April, July, and October. Climatological latitude-time and height-time cross sections are displayed which highlight seasonality, along with a series of diagrams for each year which illustrate the true daily variability. GRA

N88-23341# Atmospheric Environment Service, Downsview (Ontario).
UNDERSTANDING CO2 AND CLIMATE Annual Report, 1986
H. G. Hegeveld Aug. 1987 30 p
(PB88-167655) Avail: NTIS HC A03/MF A01 CSCL 04B

The issue of the annual report Understanding CO2 and Climate provides a general overview of these activities, as highlighted in the following: (1) evidence of the effects of human society and its activities on the earth's atmosphere continues to accumulate; (2) changes in atmospheric composition are expected to cause major alterations to the earth's climate; and (3) the effects on society of higher CO2 concentrations, warmer global climates, and related changes are commplex and difficult to assess. Some humans will benefit, others will suffer. Ongoing studies into how natural ecosystems, and hence how humans, are likely to react to global change are gradually adding to the knowledge base required by policy makers for appropriate response; (4) The effects of human activities on the planet's atmospheric life-support system and the implications of related changes for humans are emerging as major international policy issues. Yet the understanding of the problem is still very limited and subject to controversy, and hence becomes a major obstacle to timely and responsible policy action. GRA

N88-23342# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Wolkenphysik.
OBTAINING INFORMATION ON CLOUD PARTICLES BY A COMMERCIAL MINIATURE CAMERA
Johann Demmel and Hans-Eberhard Hoffmann Nov. 1987 38 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-87-19; ISSN-0176-7739; ETN-88-92311) Avail: NTIS HC A03/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 16 DM

A commercial miniature camera, applied originally for the image documentation of the aircraft icing, was used to get information on the phase of the cloud particles. An adapter was developed which was mounted at the bottom of the fuselage of the icing research aircraft together with the miniature camera. The performance of this cloud particle camera was investigated in laboratory tests, outdoor tests on the ground, and during flights. Images of cloud particles with diameters from 250 microns show that completely solid particles, solid particles with a fluid surface and completely fluid particles can be discriminated from the images on the basis of their shape and their interior structure of density. ESA

N88-23343# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abteilung Meteorologische Modelle.
THE GERMAN FRONT EXPERIMENT 1987: EXPERIMENTAL DESIGN
Klaus-Peter Hoinka and Hans Volkert Oct. 1987 55 p In GERMAN; ENGLISH summary
(DFVLR-Mitt-87-24; ISSN-0176-7739; ETN-88-92316) Avail: NTIS HC A04/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 16 DM

The German Front Experiment 1987 takes place during the period 1 Oct. to 18 Dec., 1987. It measures the dynamical and thermodynamical structure of cold fronts on their way towards the Alps and studies the impact of the orography. ESA

N88-23344# World Climate Programme, Geneva (Switzerland).
WMO REGION 2/REGION 5 TRAINING SEMINAR ON CLIMATE DATA MANAGEMENT AND USER SERVICES
1987 122 p Seminar held in Yogyakarta, Indonesia, 21-28 Oct. 1985
(WCP-133; WMO/TD-189; ETN-88-92207) Avail: NTIS MF A01; print copy avail. at World Meteorological Organization, Case Postale No. 5, CH-1211 Geneva 20, Switzerland

Using CLICOM for climate data entry, quality control, data archiving and retrieval, and preparation of user products; using the climatic data base to assist agricultural planning; continuous simulation models for natural resources planning and management, decentralized climate data management and user services; application of climate impact assessment in Indonesia; and models of climatological analysis and seasonal forecasting in Indonesia were discussed. ESA

N88-23345# World Climate Programme, Geneva (Switzerland).
A DROUGHT WATCH SYSTEM
W. J. Gibbs Jun. 1987 50 p
(WCP-134; WMO/TD-193; ETN-88-92208) Avail: NTIS MF A01; print copy avail. at World Meteorological Organization, Case Postale No. 5, CH-1211 Geneva 20, Switzerland

It is shown that an effective drought watch system can be established with modest resources. Essential requirements are reliable rainfall observations from a representative network of stations for a period of not less than 20 but desirably longer than 50 yr, statistical analysis of these data giving 5th, 10th, and 50th percentiles and others as required; a telecommunications system enabling the rapid collection of rainfall data at the end of each month; and means of production of a drought review. A useful index of drought is the occurrence of a rainfall total, over a period of some months, within the first decile range (i.e., below the 10th percentile). Using this, or similar percentile criteria, it is possible to establish an effective drought watch system which, in Australia is found to be useful for farmers, economists, and political leaders. ESA

N88-23346# European Space Agency, Paris (France).
STANDARDIZED ICE ACCRETION THICKNESS AS A FUNCTION OF CLOUD PHYSICS PARAMETERS
Hans-Eberhard Hoffmann, Roland Roth, and Johann Demmel (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) Mar. 1988 64 p Transl. into ENGLISH of Die Normierte Eisansatzdicke in Abhaengigkeit von Wolkenphysikalischen Parametern (Oberpfaffenhofen, Fed. Republic of Germany, DFVLR), Jan. 1987 64 p Original language document was announced as N88-10464
(ESA-TT-1080; DFVLR-FB-87-08; ETN-88-92561) Avail: NTIS HC A04/MF A01; original German version available from DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany 24.50 DM

Normalized ice accretion thickness was studied using the measurement results of 38 icing research aircraft flights in icing clouds. Normalized ice accretion is the ice accretion thickness on 3 metal cylinders in flow direction, for a true air speed of 125 kt, and a flight path in clouds of 10 NM (i.e., 18.5 km). In the

investigated range of liquid water content up to 0.50 g/cum, the normalized ice thickness grows linearly with increasing liquid water content; it is a little larger for cloud particules freezing instantaneously. The thickness is larger for smaller cylinder diameters. In the temperature range between minus 2 and minus 14 C, a difference in temperature has only a little influence, differences in particle phase and particle size distribution have no influence on the normalized ice accretion thickness. ESA

N88-23347# National Center for Atmospheric Research, Boulder, Colo.
NONLINEAR NORMAL MODE INITIALIZATION OF THE NCAR (NATIONAL CENTER FOR ATMOSPHERIC RESEARCH) CCM (COMMUNITY CLIMATE MODEL)
R. M. Errico and B. E. Eaton Sep. 1987 117 p
(Grant NSF ATM-87-09659)
(PB88-171814; NCAR/TN-303-1A) Avail: NTIS HC A06/MF A01 CSCL 04B

Software developed by the Global Dynamics Section of NCAR for use with the Community Climate Model (CCM) is documented. The contribution provides both NCAR and the university community with software for initializing the model, for examining atmospheric data, and for investigating model dynamics, with respect to the model's normal modes. The software was designed for use specifically with model versions CCMOB and CCMI. It is especially designed for investigators who want software computationally efficient, simple to use, and easy to modify. Author

N88-23348# National Center for Atmospheric Research, Boulder, Colo.
TAIWAN AREA MESOSCALE EXPERIMENT: DAILY OPERATIONS SUMMARY
J. B. Cunning Jan. 1988 360 p
(Grant NSF ATM-87-09659)
(PB88-169081; NCAR/TN-305-STR) Avail: NTIS HC A16/MF A01 CSCL 04B

The Taiwan Area Mesoscale Experiment (TAMEX), is an experiment to understand the mesoscale dynamics and microphysical processes responsible for heavy precipitation that leads to flash floods in Taiwan. There were 13 intensive observational periods to conduct investigations of: (1) the mesoscale circulations associated with the MEI-Yu front, (2) the mesoscale convective system that develop within the front, and (3) the effects of the topography of Taiwan on the mean flow, the MEI-Yu front, and mesoscale convective systems. The daily activities that occurred during the field program are summarized, along with an overview of the instrumentation systems that operated as part of TAMEX. The summary in conjunction with the P-3 Aircraft Operations Summary and the Doppler Radar Operations Summary, provides researchers with a nearly complete picture of what data were collected and archived in the program and how to access it. The Data Summary provides the information on the data formats of tapes from the various instrumentation systems. Author

N88-23349# National Weather Service, Silver Spring, Md. Techniques Development Lab.
VERY SHORT RANGE STATISTICAL FORECASTING OF AUTOMATED WEATHER OBSERVATIONS Final Report, Oct. 1986 - Sep. 1987
Robert G. Miller Jan. 1988 241 p
(Contract DTFA01-83-Y-20625)
(AD-A190803; DOT/FAA/PS-88/3) Avail: NTIS HC A11/MF A01 CSCL 04B

A procedure is developed for providing weather forecasting guidance over the short range period of 10, 20, 30..., 120 minutes. It uses the Automated Weather Observing System (AWOS) elements as predictors and predictands. The model is founded on Markov assumptions and uses multivariate regression as the statistical operator. Details are given on how the Generalized Exponential Markov (GEM) model compares with persistance. Tests are performed on a test sample of almost 400,000 cases. Overall, GEM succeeds in bettering current short range weather forecasting techniques (i.e., persistence) over the twelve projection periods of 10, 20, 30..., 120 minutes. The ability of GEM to successfully predict VFR to IFR, and IFR to LOW IFR changes in both visibility and ceiling is also demonstrated. GRA

N88-23350# State Univ. of New York, Albany. Atmospheric Sciences Research Center.
FOG, RAIN AND AEROSOL ATTENUATION IN THE ATMOSPHERE Final Report, 1 Apr. 1984 - 31 Aug. 1987
G. G. Lala, David R. Fitzjarrald, and Michael B. Meyer 31 Dec. 1987 60 p
(Contract DAAG29-84-K-0050)
(AD-A190867; ARO-21143.1-GS) Avail: NTIS HC A04/MF A01 CSCL 04B

Large scale meteorological influences as well as local fog climatology were investigated and a simple model based on standard weather observations was formulated to explain seasonal trends in fog occurrence. Detailed studies of surface layer and boundary layer structure during fog events are summarized. The importance of initial conditions in determining the potential for fog formation are discussed. The roles of long wave radiational cooling and turbulent transport in promoting fog formation in each of these regions were investigated. In many cases, radiational cooling is the dominant mechanism responsible for bringing a deep layer to saturation. Local winds, such as the channeled flow in the Hudson valley, may act either to promote or to prevent fog formation. From this analysis, it is clear that standard surface and upper air observations alone are inadequate inputs for fog forecasting, but must be augmented with more detailed boundary layer observations. Continuous samples of droplet spectra in fog obtained with a forward scattering droplet spectrometer were analyzed to investigate the shape of the size distribution as a function of time. GRA

N88-23351# Naval Postgraduate School, Monterey, Calif.
THE ROLE OF VORTEX STRUCTURE IN TROPICAL CYCLONE MOTION Ph.D. Thesis
Michael Fiorino Dec. 1987 371 p
(AD-A190961) Avail: NTIS HC A16/MF A01 CSCL 04B

The role of vortex structure in tropical cyclone motion is studied using a moving-grid, nondivergent barotropic model on a beta plane in a no flow environment. Initial condition sensitivity tests reveal that the northwestward beta drift of the vortex is controlled by the symmetric circulation in the $r = 300$ to 800 km critical annulus. Enhanced cyclonic or anticyclonic flow in this critical annulus leads to long-term cyclonic or anticyclonic turning motions. The dynamics of the motion process is examined in terms of the symmetric and asymmetric circulations. When the vortex is moving in a quasi-steady manner, the asymmetric flow appears as a pair of large-scale, counter-rotating gyres. A second much smaller pair is found near the center. The interaction between these two sets of gyres and the symmetric flow governs the motion process as revealed by a streamfunction tendency analysis and dynamical sensitivity tests in which the model equation is modified during the integration. Beta drift can be described as a balancing process between linear Rossby dispersion which generates the asymmetric gyres and nonlinear advection that moves the vortex to limit gyre development. Vortex structure is the key to this balance as it determines both the linear generation of the asymmetric forcing and the nonlinear interaction between the symmetric and asymmetric circulations. GRA

N88-23352# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
TDWR (TERMINAL DOPPLER WEATHER RADAR) CLUTTER RESIDUE MAP GENERATION AND USAGE
Dwayne R. Mann 29 Jan. 1988 26 p Original contains color illustrations
(Contracts F19628-85-C-0002; DTFA01-80-Y-10546)
(AD-A191148; ATC-148; DOT/FAA/PM-87/26) Avail: NTIS HC A03/MF A01 CSCL 17I

The Terminal Doppler Weather Radar (TDWR) system is designed to provide high quality low altitude Doppler radar data near airports. Ground clutter suppression will be a major challenge

to supplying such high quality Doppler data. To confront this challenge the FAA has specified stringent clutter suppression requirements in the TDWR technical specifications. These specifications are designed to provide an effective clutter suppression system. In particular, the specifications require an antenna with narrow beam width and low side-lobes to minimize ground target illumination. Also, a high pass frequency filter (with a stop attenuation in excess of 50 dB) is required to reduce stationary clutter. Finally, a clutter residue map editing system is used to remove remaining clutter. This report describes the algorithms used to generate and use the clutter residue editing system. The major issues are discussed followed by a description of the algorithms designed to address these issues. Finally, preliminary experimental results using a clutter residue map are presented. GRA

N88-23353# Wisconsin Univ., Madison. Space Science and Engineering Center.
VALIDATE ALGORITHMS FOR THE DETERMINATION OF RAINFALL RATES FROM SSM/I MICROWAVE SATELLITE IMAGERY Progress Report, Oct. - Nov. 1987
Nov. 1987 10 p
(Contract N00014-86-K-2001)
(AD-A191337) Avail: NTIS HC A02/MF A01 CSCL 17I

Since the end of September, our primary activities were: (1) amassing an extensive catalog of radar and raingage data over our primary and secondary validation sites that correspond to SSM/I overpass times occurring between July 19 and Sept. 30, 1987; (2) ordering radar and calibrating raingage data for cases in this catalog; (3) ordering the SSM/I data for the same cases; (4) writing the software necessary for unpacking calibrated rain data from the United Kingdom; (5) upgrading the navigation of radar bins, based upon the geometry of radar beam propagation and the geodetic formulae of Sodano (Bull. Geodesique, 1965); and (6) imaging the 25 km resolution radar rain rate fields produced by our data merging programs (see Validation Software section). We are just beginning to analyze the radar from our primary validation sites, comparing this data with the limited number of orbits of SSM/I data so far received. We are also continuing our cooperation with scientists of the Severe Storms Branch of NASA/Goddard Space Flight Center in order to expedite the radiative transfer modeling necessary for the analysis and improvement of the current rain rate algorithm. GRA

N88-23354# Air Force Geophysics Lab., Hanscom AFB, Mass.
RAINFALL RATES AND DROP-SIZE DISTRIBUTIONS FOR ENVIRONMENTAL TESTING
Paul Tattelman 25 Feb. 1988 4 p
(AD-A191342; AFGL-TR-88-0046) Avail: NTIS HC A02/MF A01 CSCL 04B

Rainfall rates and associated drop-size distributions are important considerations in the design and testing of most items that must operate in and withstand the effects of weather. Erosion of aerospace vehicles, triggering of impact fuses and leakage into sealed components are some examples of the many ways that rain can impact different types of hardware. To properly design and test systems and equipment for rain, appropriate intensities and associated drop-size distributions need to be determined. This paper discusses the pertinent climatic data available on rain, how they were used to derive the design values presented in MIL-STD-21OC, and how to determine the appropriate intensity values for each system's intended life cycle. GRA

N88-23355*# Alabama Univ., Huntsville.
ATMOSPHERIC SCIENCE AND REMOTE SENSING LABORATORY Annual Report, 1987-1988
Douglas Mach and David Bowdie 20 Apr. 1988 15 p
(Contract NAS8-36279)
(NASA-CR-179290; NAS 1.26:179290) Avail: NTIS HC A03/MF A01 CSCL 04B

During the contract year, scientific research on lightning and lightning hazards was carried out for the Atmospheric Electricity Group in the MSFC Remote Sensing Branch (ED43). These tasks included research on modeling the interaction of lightning optical pulses and cloud particles, estimating lightning hazard threats to the STS system, a small field project to determine the charge structure of winter and stratiform thunderstorms, and analysis of optical pulse data. These activities were performed in conjunction with the ED43 mission to develop a lightning mapper to be placed on one of the GOES-next operational satellites. Author

N88-23599# Deutscher Wetterdienst, Hamburg (West Germany). Meteorologisches Observatorium.
SPECTRORADIOMETRY IN METEOROLOGY [SPEKTRALRADIOMETRIE IN DER METEOROLOGIE]
K. Dehne *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 216-238 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-23356# Hawaii Univ., Honolulu. Sea Grant Coll. Program.
TWO DECADES OF ACHIEVEMENT IN THE OCEAN, 1968-1988
Jan. 1988 119 p Sponsored by NOAA, Rockville, Md.
(PB88-167077; UNIHI-SG-MR-88-01) Avail: NTIS HC A06/MF A01 CSCL 08C

This document represents the collective effort of the Sea Grant people who were themselves actors in the 20 year drama of the University of Hawaii Sea Grant College Program (UHSGCP) at work in the ocean with ocean people. It is the story of the meeting of university scientists at the last frontier of the earth (the ocean), a beautiful but formidable environment. The major endeavors and contributions of the UHSGCP are descrived in the three major divisions of the report, which are: Overview: Program History and Program Management; major programs and achievements; and long-range effects. GRA

N88-23357 Max-Planck-Inst. fuer Meteorologie, Hamburg (West Germany).
INVESTIGATION OF THE IMAGING OF OCEAN SURFACE WAVES USING A SYNTHETIC APERTURE RADAR [UNTERSUCHUNG DER ABBILDUNG VON OZEANOBERFLAECHENWELLEN DURCH EIN SYNTHETIC APERTURE RADAR]
Claus Bruening 1987 98 p In GERMAN
(Ser-A-Wiss-Abhandl-84; ETN-88-91470) Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany, 20 DM

The imaging of long, wind-induced ocean waves by a SAR using a two-dimensional Monte Carlo simulation model was investigated. It is shown that the nonlinear distortions in the SAR-imaging are essentially due to phase modulation and Doppler broadening of the SAR-signal by the subscale orbital velocities of backscattered SAR-signal. The pronounced azimuthal decay of the spectral energy density in the SAR-variance spectrum is due to the Doppler-broadening-induced reduction of the azimuthal resolution, and limits the signal-to-noise ratio of the signal. The validity of the SAR-simulation model was demonstrated by comparison with SAR-variance spectra taken by the Shuttle Imaging Radar. ESA

N88-23358# World Climate Programme, Geneva (Switzerland).
THE WOCE CORE PROJECT PLANNING MEETING ON THE GYRE DYNAMICS EXPERIMENT
Sep. 1987 47 p Meeting held in London, United Kingdom, 2-5 Sep. 1986
(WCP-139; WMO/TD-192; ETN-88-92209) Avail: NTIS MF A01;

print copy avail. at World Meteorological Organization, Case Postale No. 5, CH-1211 Geneva 20, Switzerland

Aspects which a study of ocean gyre dynamics should address were defined. The ocean surface layer, ocean interior, and deep circulation were discussed. Apart from a deep circulation experiment in the Brazil basin, the favored site is the North Atlantic. ESA

N88-23359# National Marine Fisheries Service, Monterey, Calif. Fisheries Environmental Group.

HYDROGRAPHIC OBSERVATIONS IN THE NORTHWESTERN WEDDELL SEA MARGINAL ICE ZONE DURING MARCH 1986

D. M. Husby and R. D. Muench Jan. 1988 39 p Prepared in cooperation with Science Applications International Corp., Bellevue, Wash.

(PB88-173240; NOAA-TM-NMFS-SWFC-106) Avail: NTIS HC A03/MF A01 CSCL 08C

Temperature and salinity observations were made from the surface down to 1500 m, in the central northwestern Weddell Sea, during March 1986. These observations sampled the three water masses characterizing the region. The uppermost, Surface Water, layer extended down to 30-50 m, had temperature from near freezing (-1.8 C) up to about 0 C and salinities of 33-34 ppt. A layer of Weddell Winter Water underlay the Surface Water, extending down to about 100 m, and had temperatures of -1.5 to -1.7 C and a salinity of about 34.46 ppt. The Weddell Warm Deep Water extended from the bottom of the Winter Water down to more than 1500 m, displaying temperature increasing with depth to a maximum of about 0.5 C near 500 m then decreasing down to 1500 m. The temperature maximum region within the Warm Deep Water decreased in depth eastward, toward the center of the gyre, within the core. The baroclinic circulation, expressed as dynamic topography of the surface relative to the 1500 db level, was insignificant throughout the region. GRA

N88-23360# National Oceanic and Atmospheric Administration, Seattle, Wash. Marine Environmental Lab.

GEOSTROPHIC FLOW IN THE CENTRAL BERING SEA, FALL 1986 AND SUMMER 1987

R. K. Reed, J. D. Schumacher, and A. T. Roach Jan. 1988 19 p

(PB88-174354; NOAA-TR-ERL-433; PMEL-38) Avail: NTIS HC A03/MF A01 CSCL 08C

Data from a synoptic CTD survey over a large region in the central Bering Sea in fall 1986 are used to derive the major features of circulation. Geopotential topographies reveal the following flows: (1) a well developed eastward flow that subsequently turned toward the northwest; (2) cyclonic gyre north of Amukta Pass; and (3) a weak flow, with some local intensifications, paralleling the continental slope. Comparison of results from various circulation patterns suggests that the eastward flow that turns toward the northwest frequently occurs. Author

N88-23361# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

NUMERICAL SIMULATION OF COASTAL UPWELLING PHENOMENA IN CABO FRIO (RJ) THROUGH A TWO LAYER FINITE ELEMENT MODEL [SIMULACAO NUMERICA DO FENOMENO DA RESSURGENCIA COSTEIRA EM CABO FRIO (RJ) ATRAVES DE UM MODELO EM ELEMENTOS FINITOS DE DUAS CAMADAS]

J. A. Lorenzzetti, Keiko Tanaka, and John D. Wang (Miami Univ., Fla.) Feb. 1988 20 p In PORTUGUESE; ENGLISH summary (INPE-4502-RPE/561) Avail: NTIS HC A03/MF A01

A two-layer finite-element model is implemented to study the upwelling phenomenon in the Cabo Frio (R.J.) coastal region. A numerical run using a uniform, steady northeast wind field is analyzed. The model results show by interface, surface elevations, and flow fields some features that agree qualitatively with field observations for that region. Author

N88-23362# Naval Underwater Systems Center, New London, Conn.

LOW FREQUENCY OCEAN AMBIENT NOISE: MEASUREMENTS AND THEORY

William M. Carey and David G. Browning 14 Dec. 1987 21 p (AD-A191188; NUSC-TD-8175) Avail: NTIS HC A03/MF A01 CSCL 20A

Low frequency ocean ambient noise data are reviewed and summarized. The experimental data, both omnidirectional and directional, when not dominated by shipping noise, are shown to suggest wind dependent noise at the low frequencies (less than 500 Hz). Candidate mechanisms are examined with the result that wave-turbulence interaction at low sea states and collective bubble oscillations at high sea states are identified as possible sources of this sound. A description of the sonic properties of bubbly water is presented for low void fractions consistent with those observed in bubble clouds and plumes produced by breaking waves. A description of the collective bubble water mixture as the resonant oscillation of a flexible volume with a sonic speed determined by the properties of the mixture is presented. GRA

N88-23293# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

THE REPRESENTATION OF THE SEA-BOTTOM IN DEEP SEA AREAS BY THE DIGITAL TERRAIN MODEL (DTM) PROGRAM TASH

Hinrich Claussen *In its* Contributions to Geodesy, Photogrammetry and Cartography. Series 1, Number 46 1987 p 183-191 (For primary document see N88-23279 16-43)

Avail: NTIS HC A11/MF A01

51 LIFE SCIENCES (GENERAL)

N88-23363# Utah Univ., Salt Lake City.

BEHAVIOR, PHYSIOLOGY AND ENERGY DEPOSITION IN RATS CHRONICALLY EXPOSED TO 2450 MHz RADIATION

J. A. DAndrea and O. P. Gandhi Nov. 1987 149 p (Contract EPA-68-02-3458)

(PB88-171418; EPA-600/1-87-012) Avail: NTIS HC A07/MF A01 CSCL 06C

The research program was initiated to determine both the specific absorption rate (SAR) and the behavioral and physiological consequences of chronic CW microwave radiation exposure at 2450 MHz in the laboratory rat. Whole-body average and local SARs at discrete sites within the body of the rats and mice were determined experimentally using different exposure systems and analytical techniques. The whole-body average SAR and the distribution of SAR within the body depends on a variety of factors; type of exposure system, polarization of the field, size of the animal, and angle of radiation incident on the body. Three experiments were conducted to determine the effects of chronic exposure to 2450 MHz microwave radiation on several measures of rat behavior and physiology. Groups of rats were exposed intermittently to 2450 MHz radiation at power densities of 0.5 mW/sq cm or 2.5 mW/sq cm for 90 days. GRA

N88-23364# North Carolina Biotechnology Center, Research Triangle Park.

NORTH CAROLINA BIOMOLECULAR ENGINEERING AND MATERIALS APPLICATIONS CENTER (NC-BEMAC) Final Report, 1 May 1984 - 31 Oct. 1987

R. D. Bereman, M. A. Crenshaw, A. L. Crumbliss, R. W. Henkens, and P. D. Rilleman 29 Dec. 1987 26 p (Contract N00014-84-C-0183)

(AD-A190923) Avail: NTIS HC A03/MF A01 CSCL 06A

The overall objective of this program was to initiate a multi-disciplinary and multi-institutional research program involving the innovative application of biotechnology to materials science problems. Techniques for the immobilization and activity characterization of bovine carbonic anhydrase on porous silica

beads and graphite rods have been developed. The enzyme immobilized on porous silica beads maintains catalytic activity in nearly anhydrous organic solvents. Polyclonal (rabbit) and monoclonal (murine) antibodies to carbonic anhydrase have been developed for enzyme immobilization applications. We have successfully prepared and characterized several low molecular weight complexes containing low valent transition metals which have potential for binding and activating small, biologically, relevant molecules. Multinuclear variable temperature NMR has been successfully utilized to study the solution dynamics of these complexes. A polyanionic sulfated glycoprotein was isolated from a molluscan shell, combined with various polymeric substrates, and found to induce mineralization at the interface with an aqueous solution. The minerals defined included various forms of calcium carbonate and of calcium phosphate. In order to induce bulk mineralization, strong hydrogels were prepared and seeded with a calcium phosphate microphase and further extensive mineralization was achieved throughout the material. GRA

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-23365# Rice Univ., Houston, Tex. Dept. of Physics.
STUDIES OF MODEL ION CHANNELS IN DEFECT-FREE MULTIBILAYERS OF PHOSPHOLIPIDS Annual Report, Oct. 1986 - Sep. 1987
Heuy W. Huang 15 Nov. 1987 4 p
(Contract N00014-86-K-0087; DA Proj. RR0-4108)
(AD-A188740) Avail: NTIS HC A02/MF A01 CSCL 06A

Model ion channels such as gramicidin, melittin and alamethicin exhibit functional similarities to physiological channels, including voltage-gating, selectivities, activation and inactivation. A great deal is known about the functional (electrical) properties of model channels, but with the exception of gramicidin (which is not a voltage-gated channel) little progress has been made in determining the structures of the channels in membrane. We have developed a technique of preparing defect-free lipid multibilayers with ion channels embedded in them, so that spectroscopic and scattering measurements of aligned ion channels in electric field can be made. CD studies of alamethicin channels showed the important orientation effect of helical peptides on CD and conformation changes of the channel with sample conditions. GRA

N88-23366# Technische Hogeschool, Eindhoven (Netherlands).
DYNAMIC PROPERTIES OF HUMAN BRIGHTNESS PERCEPTION Ph.D. Thesis
Huib deRidder 1987 136 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(ETN-88-92243) Avail: NTIS HC A07/MF A01

Brightness-scaling and brightness-matching experiments are described. Results suggest a stable monotonic relation between brightness and luminance. A dynamic brightness model proves able to describe the influence of flash duration on this brightness-luminance relation, suggesting that the dynamic brightness model can predict the perceived brightness of relatively fast-changing stimuli. A 1 deg field with dark surround was employed to determine the temporal impulse response of the transient channel, using agitation as detection criterion. The Broca-Sulzer effect was measured against an extended background by brightness matching and/or scaling. The finding that the Broca-Sulzer effect is predicted from the impulse response suggests that the same mechanism (transient channel) is involved. Under certain conditions the time constants of the visual system are smaller for 1 deg fields flashed against a dark background than for those flashed against a photopic background. ESA

N88-23367# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Flugmedizin.
LEG VOLUME CHANGE UNDER LOWER BODY NEGATIVE PRESSURE (LBNP) IN DEPENDENCE ON STRATIFICATION Ph.D. Thesis - Technische Hochschule
Anna Mueller Nov. 1987 78 p In GERMAN; ENGLISH summary
(DFVLR-FB-87-47; ISSN-0171-1342; ETN-88-92319) Avail: NTIS HC A05/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 28 DM

Ten male volunteers were used to study the reaction of peripheral circulation to lower body negative pressure (LBNP) in dependence on the stratification of the leg. The LBNP was applied in four different leg stratifications with increasing inflexion in hip and knee joint. Ultrasound plethysmography, peripheral vein pressure, light-reflexion rheography, count of erythrocytes, hematocrit, hemoglobin, and caffplethysmography are discussed. It is shown that up to -2 kPa the extent of the volume shift depends on stratification. Higher muscle rigidity in extended legs decreases the volume shift into the interstitium, while there is no difference between -2 and -4 kPa in relaxed muscles. Above -4 kPa the influence of stratification on the extent of volume shift is decreased. Results are discussed on the basis of functional anatomy. ESA

N88-23368# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
MODELS DESCRIBING MUSCLE BEHAVIOR AND CONTROL
M. M. vanPaassen Oct. 1987 77 p
(LR-522; B8733272; ETN-88-92464) Avail: NTIS HC A05/MF A01

Literature on models of (human) muscle control was surveyed. Three elements are distinguished in quantitative modelling of the muscle output function: the mechanical muscle output for a certain neural stimulation; the generation of this stimulation by the controlling neurons in the spinal cord, under the influence of signals from the central nervous system and feedback signals from the muscle receptors (tendon organ and muscle spindle); and generation of feedback signals by these muscle receptors. General models describing these three processes are only known for linear simulations. In these cases the parameters are fit to the observations in a specific task. Nonlinear models which, if accurate enough, could simulate the entire muscle behavior with a single set of parameters are not available. Especially concerning the processes in the spinal cord and the muscle spindle responses no accurate models are known. ESA

N88-23369* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 310)
May 1988 102 p
(NASA-SP-7011(310); NAS 1.21:7011(310)) Avail: NTIS HC A06 CSCL 06E

This bibliography lists 305 reports, articles, and other documents introduced into the NASA scientific and technical information system in April, 1988. Author

N88-23039# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL RESEARCH ON SKIN REFLECTION, TRANSMISSION, ABSORPTION OF LIGHT RAYS
Jianmin Tang and Changyu Fu *In its* JPRS Report: Science and Technology. China 14 Jan. 1988 p 32-39 Transl. into ENGLISH from Zhongguo Jiguang (Shanghai, People's Republic of China), v. 14, no. 2, 20 Jul. 1987 p 435; 440-443 (For primary document see N88-23036 16-31)
Avail: NTIS HC A07/MF A01

N88-23378*# McDonnell-Douglas Astronautics Co., St. Louis, Mo. Human Performance Lab.
PUPIL MEASURES OF ALERTNESS AND MENTAL LOAD
Richard W. Backs and Larry C. Walrath *In* NASA. Langley

Research Center, Mental-State Estimation, 1987 May 1988 p 111-122 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 06S

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-23370*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MENTAL-STATE ESTIMATION, 1987
J. Raymond Comstock, Jr., comp. May 1988 393 p Workshop held in Williamsburg, Va., 3-4 Jun. 1987; sponsored by NASA, Langley Research Center, Hampton, Va. and Old Dominion Univ., Norfolk, Va. Sponsored by NASA, Washington
(NASA-CP-2504; L-16420; NAS 1.55:2504) Avail: NTIS HC A17/MF A01 CSCL 05J

Reports on the measurement and evaluation of the physiological and mental state of operators are presented. For individual titles, see N88-23371 through N88-23397.

N88-23371*# Advanced Resource Development Corp., Columbia, Md.
AN OVERVIEW OF CURRENT APPROACHES AND FUTURE CHALLENGES IN PHYSIOLOGICAL MONITORING
Richard L. Horst *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 25-42 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

Sufficient evidence exists from laboratory studies to suggest that physiological measures can be useful as an adjunct to behavioral and subjective measures of human performance and capabilities. Thus it is reasonable to address the conceptual and engineering challenges that arise in applying this technology in operational settings. Issues reviewed include the advantages and disadvantages of constructs such as mental states, the need for physiological measures of performance, areas of application for physiological measures in operational settings, which measures appear to be most useful, problem areas that arise in the use of these measures in operational settings, and directions for future development. Author

N88-23372*# GMS Engineering Corp., Columbia, Md.
TOWARD A MATHEMATICAL FORMALISM OF PERFORMANCE, TASK DIFFICULTY, AND ACTIVATION c54
George M. Samaras *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 43-55 Prepared in cooperation with Advanced Resource Development Corp., Columbia, Md. (For primary document see N88-23370 16-53)
(Contract DAMD17-86-C-6027)
Avail: NTIS HC A17/MF A01 CSCL 05H

The rudiments of a mathematical formalism for handling operational, physiological, and psychological concepts are developed for use by the man-machine system design engineer. The formalism provides a framework for developing a structured, systematic approach to the interface design problem, using existing mathematical tools, and simplifying the problem of telling a machine how to measure and use performance. Author

N88-23373*# Maryland Univ., College Park.
VAGAL TONE AS AN INDEX OF MENTAL STATE
Stephen W. Porges *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 57-64 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

The utility of monitoring oscillations in the heart rate pattern as a window to the brain is discussed as an index of general central nervous system status. Quantification of the amplitude of respiratory sinus arrhythmia provides an accurate index of cardiac vagal tone. A number of studies have demonstrated the validity of this measure; the relationship between flight performance and vagal tone has also been studied. In general, the vagal tone index appears to monitor global states of the central nervous system and may be useful in screening the general state of pilots. J.P.B.

N88-23374*# Naval Medical Research and Development Command, Bethesda, Md.
CHALLENGES OF PHYSIOLOGICAL MONITORING IN A NAVY OPERATIONAL SETTING
Guy R. Banta *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 65-79 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

Challenges to physiological monitoring in the Navy include environmental extremes, acceptance of use by test subjects, data transfer, data interpretation, and capability of relating collected data to valid operational relevant criterion measures. These problems are discussed with respect to diving, electrophysiological monitoring, in-flight monitoring, aircrew fatigue, in-flight cardiac stress, and in-flight monitoring devices. J.P.B.

N88-23375*# Anacapa Sciences, Inc., Fort Rucker, Ala.
PREDICTING OPERATOR WORKLOAD DURING SYSTEM DESIGN
Theodore B. Aldrich and Sandra M. Szabo *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 81-96 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

A workload prediction methodology was developed in response to the need to measure workloads associated with operation of advanced aircraft. The application of the methodology will involve: (1) conducting mission/task analyses of critical mission segments and assigning estimates of workload for the sensory, cognitive, and psychomotor workload components of each task identified; (2) developing computer-based workload prediction models using the task analysis data; and (3) exercising the computer models to produce predictions of crew workload under varying automation and/or crew configurations. Critical issues include reliability and validity of workload predictors and selection of appropriate criterion measures. J.P.B.

N88-23376*# Naval Safety Center, Norfolk, Va.
CHRONIC STRESS AS A FACTOR IN AIRCRAFT MISHAPS
Robert A. Alkov *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 99-105 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

Naval aviation is an unusually stressful career because of the inherent demands of the work. Stress is recognized as a cause of mishaps which involve pilot error. A questionnaire was adapted from Rahe and Homes' list of stressful life events in order to determine the relationship between pilot behavioral, personality, and life change factors on the one hand and responsibility for accidents on the other. A number of factors regarding interpersonal relationships, changes in personal behavior, personality factors, and life changes were found to discriminate between pilots who were and were not at fault in accidents. J.P.B.

N88-23377*# Boeing Military Airplane Development, Wichita, Kans.
ACUTE STRESS
Robert P. Bateman *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 107-110 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

A number of case stories of aircraft accidents caused by pilot stress are related. J.P.B.

N88-23378*# McDonnell-Douglas Astronautics Co., St. Louis, Mo. Human Performance Lab.
PUPIL MEASURES OF ALERTNESS AND MENTAL LOAD c52
Richard W. Backs and Larry C. Walrath *In* NASA. Langley

Research Center, Mental-State Estimation, 1987 May 1988 p 111-122 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 06S

A study of eight adults given active and passive search tasks showed that evoked pupillary response was sensitive to information processing demands. In particular, large pupillary diameter was observed in the active search condition where subjects were actively processing information relevant to task performance, as opposed to the passive search (control) condition where subjects passively viewed the displays. However, subjects may have simply been more aroused in the active search task. Of greater importance was that larger pupillary diameter, corresponding to longer search time, was observed for noncoded than for color-coded displays in active search. In the control condition, pupil diameter was larger with the color displays. The data indicate potential usefulness of pupillary responses in evaluating the information processing requirements of visual displays. J.P.B.

N88-23379*# Washington Univ., St. Louis, Mo. Behavior Research Lab.
PROBE-EVOKED EVENT-RELATED POTENTIAL TECHNIQUES FOR EVALUATING ASPECTS OF ATTENTION AND INFORMATION PROCESSING
John A. Stern *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 123-130 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

The study of probe event related potentials (probe ERPs) is reviewed. Several recent experiments are described which seem to leave in doubt the usefulness of applying ERP to simulation and field conditions as well as laboratory situations. Relatively minor changes in the experimental paradigm can produce major shifts in ERP findings, for reasons that are not clear. However, task-elicited ERPs might be used on a flight simulator if the experimenter takes time of arrival of the eyes on a particular instrument as one variable of concern and dwell time on the instrument as a second variable. One can then look at ERPs triggered by saccade termination for fixation pauses of specified durations. It may well be that ERP to a momentarily important display will differ from that elicited by routine instrument check. J.P.B.

N88-23380*# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
STEADY-STATE EVOKED POTENTIALS POSSIBILITIES FOR MENTAL-STATE ESTIMATION
Andrew M. Junker, John H. Schnurer, David F. Ingle, and Craig W. Downey *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 131-154 Prepared in cooperation with Systems Research Labs., Inc., Dayton, Ohio (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

The use of the human steady-state evoked potential (SSEP) as a possible measure of mental-state estimation is explored. A method for evoking a visual response to a sum-of-ten sine waves is presented. This approach provides simultaneous multiple frequency measurements of the human EEG to the evoking stimulus in terms of describing functions (gain and phase) and remnant spectra. Ways in which these quantities vary with the addition of performance tasks (manual tracking, grammatical reasoning, and decision making) are presented. Models of the describing function measures can be formulated using systems engineering technology. Relationships between model parameters and performance scores during manual tracking are discussed. Problems of unresponsiveness and lack of repeatability of subject responses are addressed in terms of a need for loop closure of the SSEP. A technique to achieve loop closure using a lock-in amplifier approach is presented. Results of a study designed to test the effectiveness of using feedback to consciously connect humans to their evoked response are presented. Findings indicate that conscious control of EEG is possible. Implications of these results in terms of secondary tasks for mental-state estimation and brain actuated control are addressed. Author

N88-23381*# New York Univ., New York.
VOICE-STRESS MEASURE OF MENTAL WORKLOAD
Murray Alpert and Sid J. Schneider (Behavioral Health Systems, Inc., Ossining, N.Y.) *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 155-162 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

In a planned experiment, male subjects between the age of 18 and 50 will be required to produce speech while performing various tasks. Analysis of the speech produced should reveal which aspects of voice prosody are associated with increased workloads. Preliminary results with two female subjects suggest a possible trend for voice frequency and amplitude to be higher and the variance of the voice frequency to be lower in the high workload condition. J.P.B.

N88-23382*# Advanced Resource Development Corp., Columbia, Md.
PRIMARY TASK EVENT-RELATED POTENTIALS RELATED TO DIFFERENT ASPECTS OF INFORMATION PROCESSING
Robert C. Munson, Richard L. Horst, and David L. Mahaffey *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 163-178 (For primary document see N88-23370 16-53)
(Contracts NAS1-17576; NAS1-18019)
Avail: NTIS HC A17/MF A01 CSCL 05J

The results of two studies which investigated the relationships between cognitive processing and components of transient event-related potentials (ERPs) are presented in a task in which mental workload was manipulated. The task involved the monitoring of an array of discrete readouts for values that went out of bounds, and was somewhat analogous to tasks performed in cockpits. The ERPs elicited by the changing readouts varied with the number of readouts being monitored, the number of monitored readouts that were close to going out of bounds, and whether or not the change took a monitored readout out of bounds. Moreover, different regions of the waveform differentially reflected these effects. The results confirm the sensitivity of scalp-recorded ERPs to the cognitive processes affected by mental workload and suggest the possibility of extracting useful ERP indices of primary task performance in a wide range of man-machine settings. Author

N88-23383*# Battelle Memorial Inst., Seattle. Human Affairs Research Centers.
DEFINING AND MEASURING PILOT MENTAL WORKLOAD
Barry H. Kantowitz *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 179-188 (For primary document see N88-23370 16-53)
(Contract NCC2-228)
Avail: NTIS HC A17/MF A01 CSCL 05J

A theory is sought that is general enough to help the researcher deal with a wide range of situations involving pilot mental stress. A limited capacity theory of attention forms the basis for the theory. Mental workload is then defined as an intervening variable, similar to attention, that modulates or indexes the tuning between the demands of the environment and the capacity of the organism. Two methods for measuring pilot mental workload are endorsed: (1) objective measures based on secondary tasks; and (2) psychophysiological measures, which have not yet been perfected but which will become more useful as theoretical models are refined. Secondary-task research is illustrated by simulator studies in which flying performance has been shown not to be adversely affected by adding a complex choice-reaction secondary task. J.P.B.

N88-23384*# Purdue Univ., West Lafayette, Ind.
POPEYE: A PRODUCTION RULE-BASED MODEL OF MULTITASK SUPERVISORY CONTROL (POPCORN)
James T. Townsend, Helena Kadlec, and Barry H. Kantowitz *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 189-210 (For primary document see N88-23370 16-53)

(Grant NAG2-307)
Avail: NTIS HC A17/MF A01 CSCL 05J

Recent studies of relationships between subjective ratings of mental workload, performance, and human operator and task characteristics have indicated that these relationships are quite complex. In order to study the various relationships and place subjective mental workload within a theoretical framework, we developed a production system model for the performance component of the complex supervisory task called POPCORN. The production system model is represented by a hierarchial structure of goals and subgoals, and the information flow is controlled by a set of condition-action rules. The implementation of this production system, called POPEYE, generates computer simulated data under different task difficulty conditions which are comparable to those of human operators performing the task. This model is the performance aspect of an overall dynamic psychological model which we are developing to examine and quantify relationships between performance and psychological aspects in a complex environment. Author

N88-23385*# Purdue Univ., West Lafayette, Ind.
ESTIMATING THE COST OF MENTAL LOADING IN A BIMODAL DIVIDED-ATTENTION TASK: COMBINING REACTION TIME, HEART-RATE VARIABILITY AND SIGNAL-DETECTION THEORY
Patricia A. Casper and Barry H. Kantowitz *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 211-229 (For primary document see N88-23370 16-53)
(Contract NCC2-228)
Avail: NTIS HC A17/MF A01 CSCL 05J

Multiple approaches are necessary for understanding and measuring workload. In particular, physiological systems identifiable by employing cardiac measures are related to cognitive systems. One issue of debate in measuring cardiac output is the grain of analysis used in recording and summarizing data. Various experiments are reviewed, the majority of which were directed at supporting or contradicting Lacey's intake-rejection hypothesis. Two of the experiments observed heart rate in operational environments and found virtually no changes associated with mental load. The major problems facing researchers using heart rate variability, or sinus arrhthmia, as a dependent measure have been associated with valid and sensitive scoring and preventing contamination of observed results by influences unrelated to cognition. Spectral analysis of heart rate variability offers two useful procedures: analysis from the time domain and analysis from the frequency domain. Most recently, data have been collected in a divided attention experiment, the performance measures and cardiac measures of which are detailed. J.P.B.

N88-23386*# Purdue Univ., West Lafayette, Ind.
SHORT-TERM MEMORY LOAD AND PRONUNCIATION RATE
Richard Schweickert and Cathrin Hayt *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 231-235 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

In a test of short-term memory recall, two subjects attempted to recall various lists. For unpracticed subjects, the time it took to read the list is a better predictor of immediate recall than the number of items on the list. For practiced subjects, the two predictors do about equally well. If the items that must be recalled are unfamiliar, it is advantageous to keep the items short to pronounce. On the other hand, if the same items will be encountered over and over again, it is advantageous to make them distinctive, even at the cost of adding to the number of syllables. J.P.B.

N88-23387*# Massachusetts Univ., Worcester. Dept. of Neurology.
ATTENTION, EFFORT, AND FATIGUE: NEUROPSYCHOLOGICAL PERSPECTIVES
Ronald A. Cohen and Brian F. ODonnell *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 237-268 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

Models of attention, effort, and fatigue are reviewed. Methods are discussed for measuring these phenomena from a neuropsychological and psychophysiological perspective. The following methodologies are included: (1) the autonomic measurement of cognitive effort and quality of encoding; (2) serial assessment approaches to neurophysiological assessment; and (3) the assessment of subjective reports of fatigue using multidimensional ratings and their relationship to neurobehavioral measures. Author

N88-23388*# Massachusetts Univ., Worcester. Dept. of Neurology.
THE N2-P3 COMPLEX OF THE EVOKED POTENTIAL AND HUMAN PERFORMANCE
Brian F. ODonnell and Ronald A. Cohen *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 269-286 Sponsored in part by Alzheimer Disease Research Center; the Friedman Foundation; the Univ. of Mass. Medical Center Scientific Council; and the Sterling Morton Charitable Trust (For primary document see N88-23370 16-53)
(Grant NIA-1-P50-OAG05134)
Avail: NTIS HC A17/MF A01 CSCL 05J

The N2-P3 complex and other endogenous components of human evoked potential provide a set of tools for the investigation of human perceptual and cognitive processes. These multidimensional measures of central nervous system bioelectrical activity respond to a variety of environmental and internal factors which have been experimentally characterized. Their application to the analysis of human performance in naturalistic task environments is just beginning. Converging evidence suggests that the N2-P3 complex reflects processes of stimulus evaluation, perceptual resource allocation, and decision making that proceed in parallel, rather than in series, with response generation. Utilization of these EP components may provide insights into the central nervous system mechanisms modulating task performance unavailable from behavioral measures alone. The sensitivity of the N2-P3 complex to neuropathology, psychopathology, and pharmacological manipulation suggests that these components might provide sensitive markers for the effects of environmental stressors on the human central nervous system. Author

N88-23389*# State Univ. of New York, Binghamton. Dept. of Psychology.
PROCESSING DEFICITS IN MONITORING ANALOG AND DIGITAL DISPLAYS: IMPLICATIONS FOR ATTENTIONAL THEORY AND MENTAL-STATE ESTIMATION RESEARCH
David G. Payne and Virginia A. L. Gunther *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 287-311 (For primary document see N88-23370 16-53)
(Grant BRSG-S07RR07149-12)
Avail: NTIS HC A17/MF A01 CSCL 05J

Subjects performed short term memory tasks, involving both spatial and verbal components, and a visual monitoring task involving either analog or digital display formats. These two tasks (memory vs. monitoring) were performed both singly and in conjunction. Contrary to expectations derived from multiple resource theories of attentional processes, there was no evidence that when the two tasks involved the same cognitive codes (i.e., either both spatial or both verbal/linguistics) there was more of a dual task performance decrement than when the two tasks employed different cognitive codes/processes. These results are discussed in terms of their implications for theories of attentional processes and also for research in mental state estimation. Author

N88-23390*# State Univ. of New York, Binghamton. Dept. of Psychology and Psychiatry.
INFORMATION PROCESSING DEFICITS IN PSYCHIATRIC POPULATIONS: IMPLICATIONS FOR NORMAL WORKLOAD ASSESSMENT
Philip D. Harvey *In* NASA. Langley Research Center, Mental-State

Estimation, 1987 May 1988 p 313-323 (For primary document see N88-23370 16-53)
(Grant NIMH-MH38431)
Avail: NTIS HC A17/MF A01 CSCL 05J

In one study, schizophrenics, bipolar manics, and mentally normal individuals were administered a digit recall task. The total performance of schizophrenics looked much like that of a normal processor under a higher load level. The manics' performance was intermediate. Primary performance was particularly poor among the mentally ill subjects. In a second study, three groups in the same populations as in the first study were asked to shadow and recall verbatim eight descriptive text passages. Distraction effects were found for schizophrenics only in the areas of percentage of words correctly shadowed and recall variables; the two areas were not correlated, however. It appears that, for schizophrenics, distraction disrupts the ability to effectively shadow information to a greater extent than it disrupts the ability to encode information for recall. The two studies imply that capacity-carrying abnormalities that affect the quantity but not the quality of information processing can be useful in pointing to information processing of normal humans under high load conditions. J.P.B.

N88-23391*# EEG Systems Lab., San Francisco, Calif.
NEUROPHYSIOLOGICAL PREDICTORS OF QUALITY OF PERFORMANCE
Alan S. Gevins *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 325-335 Sponsored in part by AF; National Inst. of Neurological and Communicative Diseases and Strokes; and NSF (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

New signal processing technologies have been developed to measure spatiotemporal neurocognitive processes of the human brain. In one experiment, application of these technologies produced measurements of distributed preparatory sets which predicted the accuracy of subsequent performance. In another experiment, neuroelectric changes were found in Air Force test pilots during the incipient stages of fatigue before behavior had severely degraded. Author

N88-23392*# Washington Univ., St. Louis, Mo. Behavior Research Lab.
PHYSIOLOGICAL MEASURES AND MENTAL-STATE ASSESSMENT
John A. Stern *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 337-344 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

General considerations regarding monitoring of operators for alertness are discussed, including who should be monitored and what information should be collected. Measures that have been used to ascertain more general and persistent states of alertness are outlined, including cardiac activity, peripheral vascular activity, skin conductance, electroencephalography, pupillography, oculomotor activity, and body movements. J.P.B.

N88-23393*# NTI, Inc., Dayton, Ohio.
A CORRELATIONAL APPROACH TO PREDICTING OPERATOR STATUS
Clark A. Shingledecker *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 345-352 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

This paper discusses a research approach for identifying and validating candidate physiological and behavioral parameters which can be used to predict the performance capabilities of aircrew and other system operators. In this methodology, concurrent and advance correlations are computed between predictor values and criterion performance measures. Continuous performance and sleep loss are used as stressors to promote performance variation. Preliminary data are presented which suggest dependence of prediction capability on the resource allocation policy of the operator. Author

N88-23394*# Oklahoma Univ., Norman. Dept. of Psychology.
BRAINSTEM RESPONSE AND STATE-TRAIT VARIABLES
Kirby Gilliland *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 353-361 Sponsored in part by NTI, Inc., Dayton, Ohio (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

A series of investigations are summarized from a personality research program that have relevance for mental state estimation. Of particular concern are those personality variables that are believed to have either a biological or perceptual basis and their relationship to human task performance and psychophysiology. These variables are among the most robust personality measures and include such dimensions as extraversion-introversion, sensation seeking, and impulsiveness. These dimensions also have the most distinct link to performance and psychophysiology. Through the course of many of these investigations two issues have emerged repeatedly: these personality dimensions appear to mediate mental state, and mental state appears to influence measures of performance or psychophysiology. Author

N88-23395*# Veterans Administration Hospital, San Francisco, Calif. Speech Research Lab.
VOICE STRESS ANALYSIS
Malcolm Brenner (National Transportation Safety Board, Washington, D. C.) and Thomas Shipp *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 363-376 Sponsored by AF (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05J

In a study of the validity of eight candidate voice measures (fundamental frequency, amplitude, speech rate, frequency jitter, amplitude shimmer, Psychological Stress Evaluator scores, energy distribution, and the derived measure of the above measures) for determining psychological stress, 17 males age 21 to 35 were subjected to a tracking task on a microcomputer CRT while parameters of vocal production as well as heart rate were measured. Findings confirm those of earlier studies that increases in fundamental frequency, amplitude, and speech rate are found in speakers involved in extreme levels of stress. In addition, it was found that the same changes appear to occur in a regular fashion within a more subtle level of stress that may be characteristic, for example, of routine flying situations. None of the individual speech measures performed as robustly as did heart rate. J.P.B.

N88-23396*# School of Aerospace Medicine, Brooks AFB, Tex.
DEVELOPMENT OF A C3 GENERIC WORKSTATION: SYSTEM OVERVIEW c54
David R. Strome *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 377-380 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05H

A command, control, and communications (C3) environment is described which will be applied to the evaluation of performance of aircrews, particularly in situations in which they are subjected to chemical defense protection drugs and antihistamines. J.P.B.

N88-23397*# NTI, Inc., San Antonio, Tex.
C3 GENERIC WORKSTATION: PERFORMANCE METRICS AND APPLICATIONS c54
Douglas R. Eddy *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 381-384 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05H

The large number of integrated dependent measures available on a command, control, and communications (C3) generic workstation under development are described. In this system, embedded communications tasks will manipulate workload to assess the effects of performance-enhancing drugs (sleep aids and decongestants), work/rest cycles, biocybernetics, and decision support systems on performance. Task performance accuracy and latency will be event coded for correlation with other measures of

voice stress and physiological functioning. Sessions will be videotaped to score non-verbal communications. Physiological recordings include spectral analysis of EEG, ECG, vagal tone, and EOG. Subjective measurements include SWAT, fatigue, POMS and specialized self-report scales. The system will be used primarily to evaluate the effects on performance of drugs, work/rest cycles, and biocybernetic concepts. Performance assessment algorithms will also be developed, including those used with small teams. This system provides a tool for integrating and synchronizing behavioral and psychophysiological measures in a complex decision-making environment. Author

N88-23398# Illinois Univ., Urbana. Dept. of Psychology.
THE DISPLAY OF MULTIVARIATE INFORMATION: THE EFFECTS OF AUTO- AND CROSS-CORRELATION, RELIABILITY AND HETEROGENEITY Interim Report, Sep. 1985 - Sep. 1986
Patricia M. Jones and Christopher D. Wickens Dec. 1987 22 p
(Contract MDA903-83-K-0255; DA Proj. 2Q1-61102-B-74)
(AD-A191070) Avail: NTIS HC A03/MF A01 CSCL 12C

Process control systems typically involve many variables that can be intercorrelated with each other (cross-correlated), correlated with themselves over time (auto-correlated), and that are represented by displays possessing varying degrees of reliability. These factors are examined in an information integration task which compares the relative advantages of integral and separable displays (pentagons and staggered bargraphs). The degree of cross-correlation between the cues and the heterogeneity of cue reliability (equal or differing values between the cues) was varied factorially between subjects; the input dynamics (auto-correlated or random over time) and display (pentagon or bargraph) were varied factorially within subjects. Results indicated an advantage for cross-correlated information and for the integral display given uncorrelated information. The results are interpreted within the framework proposed by Wickens and his colleagues of the display proximity advantage. GRA

N88-23399# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
PROBLEM SOLVING IN A NATURAL TASK AS A FUNCTION OF EXPERIENCE Interim Report, Jul. 1986 - Jul. 1987
Juliana S. Lancaster and Janet L. Kolodner Dec. 1987 14 p
(Contract MDA903-86-C-0173; DA Proj. 2Q1-61102-B-74-F)
(AD-A191180; ARI-RN-87-71) Avail: NTIS HC A03/MF A01 CSCL 05H

The effects of experience on problem solving behavior and the knowledge base of workers is investigated in an applied setting, i.e., automobile mechanics. The automobile is a highly complex system with many interconnected subsystems. Problem descriptions presented to a mechanic who needs to diagnose a car are usually sketchy, however. Novices are less able than experts to diagnose any but the most obvious problems. This research note concerns itself with identifying the qualitative differences between mechanics with different levels of expertise. Three student mechanics are observed in a post-secondary technical school, each at a different level of expertise, diagnosing six problems introduced into cars in the school. Collected protocols are then analyzed to find the knowledge and strategies used in solving each problem. Series of protocols for each student were also analyzed to find the changes in knowledge and strategies used in solving later problems as compared to earlier problems. Differences were seen in both the knowledge used by the subjects and their general approach to diagnosis. Based on experience, the student mechanics seemed to improve in three areas: (1) their knowledge of the relationships between symptoms and possible failures was augmented; (2) their causal models of the car's systems were augmented; and (3) their general troubleshooting procedures and decision rules were much improved. GRA

N88-23400# Illinois Univ., Champaign. Cognitive Psychophysiology Lab.
THE EVENT-RELATED BRAIN POTENTIAL AS AN INDEX OF INFORMATION PROCESSING AND COGNITIVE ACTIVITY: A PROGRAM OF BASIC RESEARCH Final Technical Report, 1 Jan. - 31 Dec. 1987
Emanuel Donchin, Michael Coles, and Arthur Kramer 29 Feb. 1988 917 p
(Contract F49620-85-C-0041)
(AD-A191244; CPL-88-1; AFOSR-88-0316TR) Avail: NTIS HC A99/MF E03 CSCL 05H

This report describes research conducted in Cognitive Psychophysiology. Our primary mission has been to develop an understanding of the Event-Related Brain Potential (ERP) so that it can be used in the study of human cognitive function and in the assessment of man-machine interactions. To this end, we have conducted research in the following areas: the use of ERPs in the study of attention and skill acquisition; the use of ERPs in the study of mental chronometry; the use of ERPs in the study of mental resources and workload; the use of ERPs in the study of memory; the development of animal model of the P300 component; and the use of ERPs as a communication channel. Listed are all chapters, papers, abstracts and presentations that were published, submitted, or in preparation in 1987. GRA

N88-23401# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
EXTENDING PROBLEM SOLVER CAPABILITIES THROUGH CASE-BASED INFERENCE Interim Report, Jul. 1986 - Jun. 1987
Janet L. Kolodner Dec. 1987 11 p
(Contract MDA903-86-C-0173; DA Proj. 2Q1-61102-B-74-F)
(AD-A191332; ARI-RN-87-82) Avail: NTIS HC A03/MF A01 CSCL 05H

This document reviews work done on case-based reasoning. In this sort of reasoning, the problem solver makes inferences based directly on previous cases rather than using the more traditional method of reliance on general knowledge. Case-based reasoning results in several enhancements to problem-solving behavior over time. First, recall of previous failures warns the problem solver of the potential for failure, and allows it to avoid the repetition of past mistakes. Second, the previous decisions that have been made are suggested to the problem solver so that its decisions do not all have to be made starting from scratch. This lessons the search space, and also serves as a way of shortcutting the constraint satisfaction process. Third, if abstract schemata can be derived from cases that have been seen previously, generalized knowledge can be augmented. This allows real shortcuts in problem solving. Decisions that previously took several steps in reasoning to make may become easier through the application of a generalized schema. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-23402# Technische Hogeschool, Delft (Netherlands). Faculty of Aerospace Engineering.
THE BIOMORPHIC MODEL OF THE HUMAN OPERATOR CONTROLLING A SINGLE OR A DOUBLE INTEGRATOR
O. H. Gerlach Dec. 1987 133 p
(LR-505; B8733282; ETN-88-92454) Avail: NTIS HC A07/MF A01

A mathematical model of the overt behavior of a human operator, when controlling a single integrator or a double integrator in a closed loop compensatory tracking task, is discussed. The aim is to achieve a close correspondence between the physiological and psychological processes going on in the actual human

controller and their mathematical simulation in the model, hence the latter is named the biomorphic model. In its initial and relatively simple version, the biomorphic model refers only to single-display, single-axis control situations. A mathematical description of the underlying psychophysical processes is given. A computer program for adjusting the free parameters in the model and calculating the latter's characteristics is presented. Quantitative applications are given and the results are compared with results from the literature. ESA

N88-23403# Illinois Univ., Urbana. Dept. of Psychology.
THE REPRESENTATIONAL CODE OF THE INTERNAL MODEL OF DYNAMIC SYSTEMS: AN INDIVIDUAL DIFFERENCES AND DUAL TASK APPROACH Interim Report
Christopher D. Wickens and Annette Weingartner Dec. 1987 40 p
(Contract MDA903-83-K-0255; DA Proj. 2Q1-61102-B-74-F)
(AD-A190876; ARI-RN-87-78) Avail: NTIS HC A03/MF A01 CSCL 05H

When a human operator monitors and controls complex dynamic processes, it is assumed that an internal representation of the process directs the operator's actions. This internal model is presumed to lie at some point along a verbal-spatial continuum. In order to determine the point on this continuum, nine subjects with high verbal and low spatial abilities, and nine with low verbal and high spatial abilities performed a multi-element failure detection task, either by itself, or concurrently with either a verbal or spatial secondary memory task. Patterns of interference between the maintaining and updating of the internal model and the performing of the memory tasks were used to infer the mode of internal model employed by the subjects. Interference results confirm that the failure detection task is spatial, and, as expected, verbal subjects performed better on the verbal secondary task and spatial subjects performed better on the spatial one. Both ability groups demonstrated similar failure detection abilities, and generated similar patterns of dual task interference. These results indicated that all subjects adopted the same strategy for failure detection. GRA

N88-23404# Dayton Univ., Ohio. Research Inst.
TASK LISTING: VISUALLY ASSISTED AND VISUALLY DEPENDENT TASKS FOR FIGHTER AIRCRAFT Final Technical Report, Dec. 1986 - Aug. 1987
Harold D. Warner Apr. 1988 24 p
(Contract F33615-84-C-0066)
(AD-A191041; AFHRL-TP-87-55) Avail: NTIS HC A03/MF A01 CSCL 05I

A comprehensive listing of visually dependent and visually assisted flight tasks in Air Force fighter and attack aircraft training was developed. Additionally, the list specifies whether the tasks are trained exclusively in daylight or also at night. The individual visual tasks are provided for 11 major areas of training: (1) takeoff and landing, (2) aerobatics, (3) aircraft handling maneuvers, (4) stalls, (5) basic formation, (6) navigation, (7) air refueling, (8) tactical formation, (9) air-to-air combat, (10) low-altitude maneuvers, and (11) surface attack. Practical applications of the task listing in aviation research and development are discussed. GRA

N88-23372*# GMS Engineering Corp., Columbia, Md.
TOWARD A MATHEMATICAL FORMALISM OF PERFORMANCE, TASK DIFFICULTY, AND ACTIVATION
George M. Samaras *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 43-55 Prepared in cooperation with Advanced Resource Development Corp., Columbia, Md. (For primary document see N88-23370 16-53)
(Contract DAMD17-86-C-6027)
Avail: NTIS HC A17/MF A01 CSCL 05H

N88-23396*# School of Aerospace Medicine, Brooks AFB, Tex.
DEVELOPMENT OF A C3 GENERIC WORKSTATION: SYSTEM OVERVIEW
David R. Strome *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 377-380 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05H

N88-23397*# NTI, Inc., San Antonio, Tex.
C3 GENERIC WORKSTATION: PERFORMANCE METRICS AND APPLICATIONS
Douglas R. Eddy *In* NASA. Langley Research Center, Mental-State Estimation, 1987 May 1988 p 381-384 (For primary document see N88-23370 16-53)
Avail: NTIS HC A17/MF A01 CSCL 05H

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-23405# North Carolina State Univ., Raleigh. Dept. of Electrical and Computer Engineering.
ALPHA STRUCTURE BASED B-HIVE MULTICOMPUTER
W. B. Wike, T. K. Miller, and D. P. Agrawal 1987 8 p
(Contract DAAG29-85-K-0236)
(AD-A188708; ARO-23062.3-EL) Avail: NTIS HC A02/MF A01 CSCL 12F

This paper describes the design and implementation of the B-HIVE multicomputer, a 24-node generalized hypercube being constructed at North Carolina State University. Each node in B-HIVE consists of a pair of tightly coupled micro computers: a National Semiconductor DB32016 processor with MMU and FPU to serve as the application processor, and an Intel 80186 processor to handle intra-nodal communications. Intra-nodal communications is via dual ported RAM. The hardware is designed to primarily support packet switched communications between nodes, but also have the capability to support a limited number of dynamically configurable circuit switched channels as well. A demand driven virtual paging mechanism has been incorporated into the design to provide inter-nodal communications which are transparent to the application software. More direct message passing via system call is supported as well. GRA

N88-23406# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
FUNDAMENTALS OF MICROPROCESSOR-BASED DESIGN: A TUTORIAL, SECOND EDITION
M. R. Johnson May 1987 72 p Presented at the 33rd Annual International Instrumentation Symposium, Las Vegas, Nev., 3 May 1987

(Contract DE-AC07-76ID-01570)
(DE88-006761; EGG-M-30286; CONF-870556-3) Avail: NTIS HC A04/MF A01

Purpose of this tutorial is to give some idea of what can be done with small microprocessor-based systems, and an appreciation of preforming function in real time. The topics are presented in logical sequence, one building on the last, rather than grouping all hardware and all software topics. Motorola's 6809 microprocessor is emphasized. We begin with the concept of programmed logic, then look at the basics of microcomputer architecture and data representation and then software topics looking at machine, assembly and high level languages and where each would best be used. We then look at a subject often neglected in microprocessor courses, data structures. Input/output devices and techniques are covered next. The tutorial concludes with a discussion of system development considerations and a quick survey of microprocessor/microcomputer families and capabilities.
Author

N88-23407# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
THE TMS32010 EVALUATION MODULE CONTROLLER
A. C. P. vanMeer Oct. 1986 46 p In DUTCH; ENGLISH summary
(EUT-86-E-162; ISBN-9-06-144162-5; ISSN-0167-9708; ETN-88-91809) Avail: NTIS HC A03/MF A01

A procedure to control the Evaluation Module EVM32010 for the Digital Signal Processor TMS32010 of Texas Instruments is presented. An Apple 2e host computer serves the EVM32010 with the help of a serial interface and a control program in 6502 Assembler language.
ESA

N88-23408# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Informatique.
CODING FOR WRITE-UNIDIRECTIONAL MEMORIES AND CONFLICT RESOLUTION
Gerard Cohen and Gabor Simonyi Sep. 1987 21 p Presented at the 1st Montreal Conference on Combinatories and Computer Science, Montreal, Quebec, 27 Apr. - 2 May 1987 Submitted for publication
(ENST-87C005; ISSN-0751-1337; ETN-88-92173) Avail: NTIS HC A03/MF A01

Write-unidirectional memories (WUM) are defined as binary storage devices able to update the information stored by writing one's or zero's to some positions of the WUM but not both at the same time. The four cases arising if the encoder or the decoder is informed/uninformed about the previous state of the memory are investigated. Bounds and conjectures on the best achievable rates when the encoder is uninformed are presented. The conflict resolution problem on a multiple access channel is discussed.
ESA

N88-23409# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Informatique.
INTRODUCTION TO THE VMS (DEC) OPERATING SYSTEM [INTRODUCTION AU SYSTEME D'EXPLOITATION VMS (DEC)]
Alexandre Zenie Feb. 1987 35 p In FRENCH
(ENST-87D006; ISSN-0757-1345; ETN-88-92176) Avail: NTIS HC A03/MF A01

The operating system used in VAX minicomputers is described. The VMS system includes large program virtual memory management, priority hierarchy determined by the actual events, protected multiuser operation, and programmed services for process control. The VMS is presented as a high performance reliable environment for multiuser, time sharing, batch, or real time operation.
ESA

N88-23410# Institut National Polytechnique, Grenoble (France). Lab. Circuits et Systemes.
DESIGN OF HIGH YIELD MICROPROCESSORS Ph.D. Thesis [CONCEPTION DE MICROPROCESSEURS A HAUT RENDEMENT]
Philippe Genestier 1987 200 p In FRENCH
(ETN-88-92184) Avail: NTIS HC A09/MF A01

Defect tolerance stragegies in integrated circuit manufacturing are studied. The improvement technique is based on dividing the circuit in blocks where less than one defect is likely to be produced, and to have available a redundant element as a reserve for each block. The reserve is implemented as a programmable line. A 16 bit microprocessor design is described. Applications to wafer scale integration are discussed.
ESA

N88-23411# Institut National Polytechnique, Grenoble (France).
AUTOMATIC LAYOUT GENERATION OF DATA PROCESSING SECTIONS OF VLSI MICROPROCESSOR-LIKE CIRCUITS Ph.D. Thesis [GENERATION AUTOMATIQUE DE PARTIES OPERATIVES DE CIRCUITS VLSI DE TYPE MICROPROCESSEUR]
Robert Jamier 1987 279 p In FRENCH; ENGLISH summary
(ETN-88-92185) Avail: NTIS HC A13/MF A01

A data processing section compiler is presented. It starts from a set of unordered operative instructions. The operative cycle is divided into four phases which correspond to the four phases of a transfer between two registers. The model is derived from the data processing section of the MC68000. The compiler produces first the architecture of the data processing section, then the layout from this architecture.
ESA

N88-23412# Argonne National Lab., Ill. Mathematics and Computer Science Div.
THE GOOD, THE BAD AND THE UGLY: COMPARING HIGH-SPEED COMPUTER SYSTEMS
K. E. Jordan Dec. 1987 15 p
(Contract W-31-109-eng-38)
(DE88-007498; ANL/MCS-TM-106) Avail: NTIS HC A03/MF A01

This paper reports the results of running a finite-difference elastic wave code on several high-speed computers, including mainframes, mainframes with vector facilities, mini-supercomputers, vector supercomputers, and vector multiprocessor mini-super and supercomputers. The numerical scheme used in the code is based on a dimensional splitting which leads in a natural way to efficient implementations on many parallel and vector systems. The results indicate that certain hardware and software features of these systems can affect overall performance if not considered by the code developer.
DOE

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-23413# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
REASONING ABOUT NETWORKS WITH MANY IDENTICAL FINITE-STATE PROCESSES Interim Report
E. M. Clarke, O. Grumberg, and M. C. Browne Dec. 1987 21 p
(Contract F33615-84-K-1520)
(AD-A188743; CMU-CS-86-155; AFWAL-TR-87-1176) Avail: NTIS HC A03/MF A01 CSCL 12G

If we consider a distributed mutual exclusion algorithm for processes arranged in a ring network in which mutual exclusion is guaranteed by means of a token that is passed around the ring, a first attempt might be to consider a reduced system with one or two processes. If the reduced system can be shown to be correct and if the individual processes are really identical, then we are tempted to conclude that the entire system will be correct. This type of informal argument is used quite frequently by designers in constructing systems that contain large numbers of identical processing elements. It is easy to contrive an example in which some pathological behavior only occurs when, say, 100 processes are connected together. By examining a system with only one or

two processes it might be quite difficult to determine that this behavior is possible. One has the feeling that in many cases this kind of intuitive reasoning does lead to correct results. The question addressed is whether it is possible to provide a solid theoretical basis that will prevent fallacious conclusions in arguments of this type. GRA

N88-23414# Rochester Univ., N. Y. Dept. of Computer Science.
IPC FOR MODULAR SOFTWARE REQUIRES A THIRD PARTY CONNECT
Stuart A. Friedberg Jun. 1987 15 p
(Contract DACA76-85-C-0001)
(AD-A189199; TR-220) Avail: NTIS HC A03/MF A01 CSCL 12G

Reconfiguration, on-line maintenance, load balancing, and similar operations on complex software require (among other things) dynamic binding of communicating peers, so that modules can be installed and removed in a frame-work of other functional modules. A binding may take the form of TCP/IP protocol connection, remote procedure call server location, shared memory address resolution, or object handle resolution, depending on the underlying communication mechanism. However, the need for abstraction and modularity is independent of the particular IPC mechanism(s) being used. A module should not need to know how it is used (specifically, how it is bound together with other modules to implement a more complex function). Therefore, the bindings between two modules A and B should in general be created and destroyed by a third module C. We call this facility a third party connect. The module C should not have to have any particular relationship (other than authentication) to modules A and B in order to dynamically connect and disconnect them. In particular, it should not have to be one of A and B, be a common ancestor of them, or have an existing binding to them. Similarly, neither A nor B should have to take an active part in establishing or tearing down bindings. GRA

N88-23415# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
DIGITAL FILTER UNIT FOR SELECTION OF SPECTROMETRIC INFORMATION
V. A. Vagov, V. E. Novozhilov, A. P. Sirotin, and V. D. Shibaev 1986 5 p In RUSSIAN; ENGLISH summary
(DE87-702990; JINR-R-10-86-562) Avail: NTIS (US Sales Only) HC A02/MF A01

The digital filter unit is intended for preliminary selection of spectrometric information. Static semiconductor storage devices K537RU2A are used as digital filters. One unit consists of three digital filters. Their parameters are given by a computer program. The switching function of each digital filter is also realized by a computer program. The unit performs in the CAMAC standard. The developed program permits using these digital filter units as a unit of a wide employment in most measurement modules without any modification of their soft and hardwares. DOE

N88-23416# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Hubschrauber und Flugzeuge.
PORTABILITY OF SOFTWARE. THE USE OF SOFTWARE IN THE HARDWARE MIXTURE [SOFTWARE PORTIEREN. SOFTWARE-EINSATZ IM HARDWARE-MIX]
Werner Fischer Jun. 1986 31 p In GERMAN
(MBB/LWD-11/S/PUB/253; ETN-88-91442) Copyright Avail: NTIS HC A03/MF A01

Portability in software engineering methods and tools is treated. The concrete necessities of portability in the global computer and software domain are explained. Portability concepts and ways to implement portability between different hardware systems are discussed. The advantages of portability, i.e., reduction of dependence on machines and men, improvement of security, product lifetime increase, and enhancement of global efficiency are discussed. ESA

N88-23417# Fraunhofer-Inst. fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (West Germany).
SOFTWARE DEVELOPMENT FOR THE RECONSTRUCTION OF SOURCE PARAMETERS USING RESEARCH AND DEVELOPMENT ARRAYS Final Report [SOFTWAREENTWICKLUNG ZUR REKONSTRUKTION VON QUELLPARAMETERN MIT HILFE DES F + E - ARRAYS]
E. Waschkies 5 Mar. 1986 19 p In GERMAN Sponsored by the Bundesministerium fuer Forschung und Technologie, Bonn, Federal Republic of Germany
(Rept-840445-TW; ETN-88-91467) Avail: NTIS HC A03/MF A01

The reconstruction of signal parameters at the sound source position was studied for the case of a linear array, with a view to the interpretation (classification) of sound emission (SE) sources. For a 6-channel sound emission research array (research and development array) software programs for optimized linear 3-probe arrays, signal parameter analysis, and on and off-line filtering of SE-signals were developed. The efficiency of the programs was demonstrated by test SE signals, recorded during thermal shock tests at a support of a reactor pressure vessel. It is shown that in this case a classification and separation of SE-signals of the type crack grouwth and crack boundary friction is possible. ESA

N88-23418# Research Inst. of National Defence, Stockholm (Sweden).
Ada USER LIBRARY
Erik G. Eriksson May 1987 102 p
(FOA-C-20657-2.7; ISSN-0347-3694; ETN-88-91882) Avail: NTIS HC A06/MF A01

It is shown how the Ada Repository of 509 files of 23 MB total, organized in 30 subdirectories can be used as a core for a program library. The most interesting subdirectories are indicated, and comparisons to a corresponding program library for the programming language SIMULA are made. ESA

N88-23419# Royal Signals and Radar Establishment, Malvern (England).
THE OFFICIAL HANDBOOK OF MASCOT, VERSION 3.7, ISSUE 1
Jun. 1987 302 p
(BR103975; ETN-88-92068) Copyright Avail: NTIS HC A14/MF A01

A handbook for the Modular Approach to Software Construction Operation and Test (MASCOT) is presented. The MASCOT incorporates a means of design representation, a method for deriving the design, a way of constructing software so that it is consistent with the design, a means of executing the constructed software so that the design structure remains visible at run time, and facilities for testing the software in terms of the design structure. Of particular importance in the design representation is the ability to represent, directly, concurrent functions and the data flows between them. Individual components in the design structure are decoupled from each other. This has a significant impact on both the design method and the testing strategy and leads directly to a form of component technology familiar in all other branches of engineering. It causes a design to be expressed as a structure (or assembly) of interconnected components each of which is of a specific type. Thus, each component type has its own characteristics and embodies constraints on where and how it may be connected to other component types. But no component refers directly to another component. Such interconnection information is specified in a separate form rather like an engineering drawing. ESA

N88-23420# Technische Hogeschool, Eindhoven (Netherlands).
EFFICIENT AND FAST DATA COMPRESSION CODES FOR DISCRETE SOURCES WITH MEMORY Ph.D. Thesis
Tjalling Jan Tjalkens 1987 147 p
(ETN-88-92233) Avail: NTIS HC A07/MF A01

Two source coding algorithms are described. Both compute the codewords from the source data instead of using a predesigned code-book. A strong similarity exists between theses schemes.

The variable to fixed length scheme is termed a combinatorial or exact coding scheme, and the arithmetic code the probabilistic or inexact one. The arithmetic code was developed from the combinatorial scheme. ESA

N88-23421# Technische Hogeschool, Delft (Netherlands).
HIFI: A DESIGN METHOD FOR IMPLEMENTING SIGNAL PROCESSING ALGORITHMS ON VLSI PROCESSOR ARRAYS Ph.D. Thesis
Jurgen Annevelink 1987 216 p
(ETN-88-92238) Avail: NTIS HC A10/MF A01

A design method, called HIFI, that makes it possible to systematically implement a large class of signal processing algorithms on systolic and wavefront arrays is defined. The model underlying the definition of the design method is a combination of a process oriented model and an applicative, function oriented model. The result is a model that combines a high level of abstraction with powerful decomposition mechanisms. The model is used to define the HIFI design method, which allows top-down and bottom-up design styles. The HIFI design-method is based on two different design steps: refinement, which makes it possible to define the decomposition of a function with a dependence graph; and partitioning, used to project a dependence graph on a so-called signal flow graph, which allows a more efficient implementation of the function defined by the dependence graph. The design method is illustrated by an algorithm for the solution of a system of linear equations, and the transitive closure algorithm. ESA

N88-23422# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
RECOGNIZING AND LOCATING PARTIALLY OCCLUDED PLANAR OBJECTS FOR ASSEMBLY ROUTINES Ph.D. Thesis - Paul Sabatier Univ.
Marc Vinesse 1987 142 p In FRENCH; ENGLISH summary
(LAAS-87-360; ETN-88-92171) Avail: NTIS HC A07/MF A01

Contributions to solve the problem of hidden objects are presented, including a modeling system which links the geometrical features on the basis of their proximity, statistical and dynamic object models, and an hypothesis merging device that allows the optimization of the prediction/verification process on which is based the identification. The implementation of this method within the framework of promip machine vision development is detailed and the experimental results are presented. ESA

N88-23423# Institut National Polytechnique, Grenoble (France).
SYNTHESIS AND SIMULATION OF SYSTOLIC ALGORITHMS Ph.D. Thesis [SYNTHESE ET SIMULATION D'ALGORITHMES SYSTOLIQUES]
Ibrahima Sakho 1987 135 p In FRENCH
(ETN-88-92183) Avail: NTIS HC A07/MF A01

A partition method is proposed for designing parallel algorithms for systolic networks composed of programmable cells. Projection methods are generalized and lead to optimum design of the initial sequential scheme. Systolic algorithms are then simulated in OCCAM language using a local synchronization mechanism. A model is proposed to evaluate the time performance improvement due to local synchronization ESA

N88-23424# Institut National Polytechnique, Grenoble (France).
COMPUTER AIDED DESIGN TOOLS FOR INTEGRATED SILICON SYSTEM STRUCTURES Ph.D. Thesis [OUTILS DE CAO ET CONCEPTION STRUCTUREE DE SYSTEMES INTEGRES SUR SILICIUM]
Francois-Rene Rougeaux 1987 227 p In FRENCH; ENGLISH summary
(ETN-88-92186) Avail: NTIS HC A11/MF A01

A hierarchical symbolic layout system is described. Graphical environments and a textual description are provided. A textual language may be used as the target language of all synthesis and compilation tools to be developed in the framework of an integrated VLSI CAD system. A LISP program defines how basic leaf-cells must be assembled to realize the desired function. Functional cells may be generated, with soft topology and soft functionality. ESA

N88-23425# Institut National Polytechnique, Grenoble (France).
SILICON COMPILERS: APPLICATION TO THE COMPILATION OF THE CONTROL AREA Ph.D. Thesis [COMPILATION DE SILICIUM: APPLICATION A LA COMPILATION DE PARTIE CONTROLE]
Patrice Varinot 1987 255 p In FRENCH; ENGLISH summary
(ETN-88-92188) Avail: NTIS HC A12/MF A01

The compilable structures of microprocessor integrated circuits are analyzed using the Von Neuman machine concept. Different schemes of the topology for control implementation are presented. Compilation tools developed are described. Examples of circuit realizations show the interest of the study. ESA

N88-23426# Grenoble-1 Univ. (France).
CONTRIBUTION TO THE AUTOMATIC GENERATION OF FLOOR PLAN PLACING Ph.D. Thesis [CONTRIBUTION A LA GENERATION AUTOMATIQUE DE PLANS DE MASSE]
Philippe Chaisemartin 1987 151 p In FRENCH
(ETN-88-92193) Avail: NTIS HC A08/MF A01

Factorial analysis is applied to the study of placing tables. Application to integrated circuit floorplan placing and optimization procedures are developed. Placement improvement is compared to traditional or iterative solutions. The ALFA computer program is based on this analysis, and it is shown to be a complete system for integrated circuits computer aided design. ESA

N88-23427# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
THE PROMISE SIMULATION SYSTEM: SOFTWARE FOR THE SIMULATION OF PARALLEL PROCESSES
G. J. Dekker, P. J. dePagter, and T. deJong 2 Dec. 1986 21 p In DUTCH; ENGLISH summary Presented at CAPE Nederland '87, Amsterdam, The Netherlands, 17-19 Mar. 1987
(Contract ESA-5649/83-D-JS(SC))
(NLR-MP-86077-U; B8731728; ETN-88-92226) Avail: NTIS HC A03/MF A01

The PROMISE simulation tool to study parallel processes that exchange discrete signals is described. Communication between processes is handled via time-tagged messages. The simulated process is modeled by models and submodels that exchange information in so-called connectors. The simulation model has a tree structure of which the elementary models are freely programmable in FORTRAN. Any (sub) model that obey the same I/O definition can be freely exchanged. The PROMISE software is portable to CYBER, IBM, and VAX mainframes due to the strict adherence of ANSI FORTRAN 77. The package is available on CYBER 180 and IBM 4381 computers. The modular design of PROMISE means that models and submodels of the simulated system can be easily exchanged by other models, for instance more detailed ones. This enables quick parameter studies and detailed studies of certain design aspects of the simulated system. Simulation studies executed using PROMISE, including studies of NAVSAT and liquid sloshing, are outlined. ESA

N88-23428# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/Dept. of Software Technology.
SEMANTICS FOR PROLOG VIA TERM REWRITE SYSTEMS
J. C. M. Baeten (Amsterdam Univ., Netherlands) and W. P. Weijland Aug. 1987 15 p Submitted for publication Sponsored in part by the European Economic Commission
(CWI-CS-R8739; B8735875; ETN-88-92394) Copyright Avail: NTIS HC A03/MF A01

Semantics for logic programs using term rewrite systems are presented. Reading program lines from left to right (so reversing the arrows), considering the result as a rewrite system, immediately gives the usual declarative semantics (the least Herbrand model). Then a priority ordering on the rewrite rules is added, giving a

N88-23442# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
ON THE TRAJECTORY OF A LINEAR PROGRAMMING PROBLEM
C. Roos 1987 22 p
(Rept-87-53; B8733836; ISSN-0920-8577; ETN-88-92432)
Copyright Avail: NTIS HC A03/MF A01

Using a potential function a conceptual interior point algorithm for the linear programming problem in inequality form is developed. The algorithm creates a sequence of points which lies on the trajectory of the problem and requires only 0(L) steps, where L is the size of the problem. ESA

N88-23443# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
THE SYNTHESIZER GENERATOR, A USEFUL TOOL?
Gertjan vanOosten and Frans Ververs 1987 18 p
(Rept-87-77; B8735612; ISSN-0920-8577; ETN-88-92452)
Copyright Avail: NTIS HC A03/MF A01

Experience with the Synthesizer Generator tool for generating language based editors and/or environments is reviewed. It is a very useful tool to construct very quickly a rather simple purely syntactic editor with a standard interface. The use of the Synthesizer Generator to develop environments consisting of a language-based editor, an interpreter, and a debugger, is very difficult. However, the Synthesizer Generator can serve as a good starting point to develop other tools. ESA

N88-23444# Vrije Universiteit, Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica
AXIOMATIC SPECIFICATION OF DATABASE DOMAIN STATICS
R. Wieringa Oct. 1987 104 p
(PB88-176284; Rept-133) Avail: NTIS HC A06/MF A01
CSCL 09B

In the past ten years, much work has been done to add more structure to database models than what is represented by a mere collection of flat relations. The first goal of the reported research is to integrate the static structures which these models propose in one coherent, axiomatic framework. It will be shown that the theory presented provides the needed conceptual foundations for these models. A second aim is to provide a possible worlds framework onto which to graft theories of the dynamics of the Universe of Discourse (UoD). The third aim is to provide clear concepts which can aid the database model designer in his or her thinking about the UoD. Author

N88-23445# Software Automation Corp., Vienna, Va.
COBOL ANALYSIS SYSTEM (CAS) USERS MANUAL
1988 243 p Sponsored by Office of Software Development and Information Technology, Falls Church, Va.
(PB88-171442; GSA/SW/MT-88/001A) Avail: NTIS HC
A11/MF A01 CSCL 09B

The COBOL Analyzer System (CAS) will validate user-written COBOL source code against COBOL ANS-74 standards and other criteria for form, content, and structure. In addition, CAS will analyze COBOL source statements for conformance to installation specific standards. Statistical summaries of installation-specific and COBOL ANS-74 standard violations are provided as well as detailed listings describing each violation. The analysis also identifies those that do not conform to structured programming standards. Externally loaded tables supply the analysis criteria and direct the flow of control of the system. GRA

N88-23446*# District of Columbia Univ., Washington, D. C. Dept. of Computer Science.
DATA MANAGEMENT AND LANGUAGE ENHANCEMENT FOR GENERALIZED SET THEORY COMPUTER LANGUAGE FOR OPERATION OF LARGE RELATIONAL DATABASES Final Report
Gail T. Finley 25 May 1988 48 p
(Grant NAG5-91)
(NASA-CR-182868; NAS 1.26:182868) Avail: NTIS HC
A03/MF A01 CSCL 09B

This report covers the study of the relational database implementation in the NASCAD computer program system. The existing system is used primarily for computer aided design. Attention is also directed to a hidden-surface algorithm for final drawing output. Author

N88-23447*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PLOT300: A TEKTRONICS PLOT10 EMULATOR FOR HP 9000 SERIES 200/300 COMPUTERS
Scott O. Kjelgaard May 1988 39 p
(NASA-TM-100606; NAS 1.15:100606) Avail: NTIS HC
A03/MF A01 CSCL 09B

A software package which emulates the Tektronics PLOT10 Graphics package on Hewlett-Packard 9000 Series 200/300 computers is described. The Software is written in HP Rocky Mountain BASIC and can be run under BASIC revisions 3.0 and 4.0. Although this subroutine library emulates a subset of PLOT10, several subroutines have been added which enhance basic plot generation. Example codes using PLOT300 and descriptions of the subroutines are included in the text. Author

N88-23448*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STRUTEX: A PROTOTYPE KNOWLEDGE-BASED SYSTEM FOR INITIALLY CONFIGURING A STRUCTURE TO SUPPORT POINT LOADS IN TWO DIMENSIONS
James L. Rogers, Stefan Feyock (VAIR, Inc., Williamsburg, Va.), and Jaroslaw Sobieszczanski-Sobieski Apr. 1988 24 p Proposed for presentation at the 3rd International Conference on Applications of Artificial Intelligence in Engineering, Stanford, Calif., 8-11 Aug. 1988
(NASA-TM-100613; NAS 1.15:100613) Avail: NTIS HC
A03/MF A01 CSCL 09B

The purpose of this research effort is to investigate the benefits that might be derived from applying artificial intelligence tools in the area of conceptual design. Therefore, the emphasis is on the artificial intelligence aspects of conceptual design rather than structural and optimization aspects. A prototype knowledge-based system, called STRUTEX, was developed to initially configure a structure to support point loads in two dimensions. This system combines numerical and symbolic processing by the computer with interactive problem solving aided by the vision of the user by integrating a knowledge base interface and inference engine, a data base interface, and graphics while keeping the knowledge base and data base files separate. The system writes a file which can be input into a structural synthesis system, which combines structural analysis and optimization. Author

N88-23449# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
PROGRAM PROFILING IN CEDAR
Allen Malony 17 Mar. 1987 42 p
(Contracts F49620-86-C-0136; DE-FG02-85ER25001)
(AD-A190883; CSRD-654; AFOSR-87-1986TR) Avail: NTIS HC
A03/MF A01 CSCL 12E

The goal of program profiling is to provide an accurate characterization of a program's behavior and performance. Program profiling can have several different meanings depending on the measurements of interest and the programming environment. Generally, profiling measurements are concerned with collecting information regarding the dynamic execution behavior of the program. The purpose is to help the user evaluate alternative implementations and to guide program optimizations. This paper presents an analysis of parallel program profiling for the Cedar multiprocessor and a preliminary functional specification of a parallel program profiling tool, cprof. The standard UNIX profiling tools serve as a beginning design basis for cprof and their basic functionality is discussed in Section 2. Section 3 describes the problems with parallel program profiling. In particular, profiling in the Cedar program execution environment is analyzed. The initial version of cprof supports routine counting and timing functionality. The proposed cprof implementation is presented in detail in Section

4. Profiling operations other than routine counting and timing are interesting for parallel programs. Section 5 briefly describes possible extensions of cprof. GRA

N88-23450# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
CONCURRENCY EFFICIENCY USER'S MANUAL Report, 1 Oct. 1986 - 30 Sep. 1987
Allen D. Malony 30 Oct. 1987 8 p
(Contract F49620-86-C-0136)
(AD-A190884; CSRD-675; AFOSR-87-1985TR) Avail: NTIS HC A02/MF A01 CSCL 12E

This document explains how to use a facility for measuring concurrency efficiency on the Alliant FX/8 implemented as part of CSRD's modifications to the Concentrix operating system. A brief overview of the concurrency efficiency analysis is presented first. The CSRD implementation is then described to point out the measurement's limitations. Concurrency efficiency measurements are directly controlled by the user program. Instructions for determining CEFF values from within a program are given. Concurrency efficiency statistics for the entire program are often desired. A tool for generating this data without requiring user program modification is described. Finally, we give some suggestions on the use of CEFF results in association with other program performance information. GRA

N88-23451# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
VPC: A PROPOSAL FOR A VECTOR PARALLEL C PROGRAMMING LANGUAGE Report, 1 Oct. 1986 - 30 Sep. 1987
Vincent A. Guarna, Jr. 30 Oct. 1987 32 p
(Contracts F49620-86-C-0136; DE-FG02-85ER25001)
(AD-A190885; CSRD-666; AFOSR-87-1969TR) Avail: NTIS HC A03/MF A01 CSCL 12E

This paper proposes a definition for VPC, an extended C programming language for vector-parallel applications. VPC is a superset of the conventional C language that contains extensions for vector and parallel machines. New constructs and their semantics are presented, along with some discussion about potential problems that arise when extending C into the parallel domain. The reader is assumed to be familiar with the C programming language--this paper only describes those aspects of VPC that differ from the standard definition. GRA

N88-23452# Illinois Univ., Urbana. Center for Supercomputing Research and Development.
SUPERCOMPUTER PROGRAMMING ENVIRONMENTS Report, 1 Oct. 1986 - 30 Sep. 1987
David A. Padua, Vincent A. Guarna, Jr., and Duncan H. Lawrie 30 Oct. 1987 31 p
(Contracts F49620-86-C-0136; DE-FG02-85ER25001)
(AD-A190887; CSRD-673; AFOSR-87-1987TR) Avail: NTIS HC A03/MF A01 CSCL 12E

The quest to apply an ever-increasing amount of computing power to numerical applications has resulted in the evolution of a broad spectrum of ideas and implementations for high performance computing systems. The architectural complexity of these high performance systems typically requires special tools and techniques to achieve efficient utilization of available computational resources. These tools range from automatic restructuring and optimizing compilers to interactive debugging and performance analysis systems. The programming environment for these systems must be general and adaptive, providing the appropriate level of assistance for users of varying levels of sophistication. This paper presents recent developments in supercomputer environments, and focuses in more detail on the Cedar Project which is currently under way at the University of Illinois Center for Supercomputing Research and Development. The Cedar Project consists of the construction of a prototype multiprocessor, restructuring compilers for the FORTRAN and C programming languages, and an integrated graphics-based programming environment intended to serve the needs of scientific applications users. GRA

N88-23453# Naval Postgraduate School, Monterey, Calif.
EDITFONT AN INTERACTIVE FONT EDITING SYSTEM M.S. Thesis
Hector J. Olivera Dec. 1987 62 p
(AD-A191007) Avail: NTIS HC A04/MF A01 CSCL 12E

The major goal of this work was the development and implementation of an interactive bit mapped font editor that enables the graphics programmer to create different fonts and icons for the use in application programs. The font editor, called editfont, was implemented on the Silicon Graphics, Inc., IRIS workstation. Editfont consists of approximately 3500 lines of code, including the program documentation. Fonts created by editfont can be retrieved from disk and high level routines implemented with the IRIS graphics library. One feature of the system is the capacity for font extraction from a picture. The steps for font generation via font extraction are explained in detail. File format, data structures and routines used by the system are also described. Software and hardware limitations of the system are outlined as well as possible future extensions. GRA

N88-23454# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION INTO THE USE OF TEXTURING FOR REAL-TIME COMPUTER ANIMATION M.S. Thesis
Timothy W. Meier Dec. 1987 118 p
(AD-A191008) Avail: NTIS HC A06/MF A01 CSCL 12E

An investigation into the use of texturizing on the Silicon Graphics, Inc., IRIS for real-time computer animation is presented. Using a tool designed specifically for the IRIS for defining texture patterns, two approaches to the design and implementation of software functions to fill objects with multi-color texture patterns are discussed. The first approach makes use of the IRIS patterning hardware to fill objects with multi-color texture patterns. Realizing the limitations of the first approach, the second approach uses an algorithm to partition a polygon defined in three space into a number of smaller polygons, with each polygon representing a texture point. GRA

N88-23455# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
APPROXIMATE AGREEMENT
Alan D. Fekete Sep. 1987 69 p
(Contracts N00014-85-K-0168; N00014-83-K-0125)
(AD-A191030; MIT/LCS/TM-342) Avail: NTIS HC A04/MF A01 CSCL 12D

This paper studies the problem of Approximate Agreement, a generalization of Byzantine Agreement, where processors are only required to obtain values that are close together, rather than identical. We offer new multi-round algorithms in several different models of computation, distinguished by the degree of synchrony in the system and the malevolence allowed to faulty processors. For each model we also examine the theoretical limits on attainable performance (measured by the reduction in the range of values), and show that our algorithm is asymptotically optimal with increasing ratio of non-faulty processors to faulty ones. There are two main conclusions we can draw from these algorithms and lower bounds. First, if process failures are restricted to faults of omission only (that is, a faulty processor is not allowed to send a wrong message, although it is allowed to crash, and therefore not send any message) then twice as much reduction can be achieved in each round of the algorithm as in a model where faults of commission are possible. This relationship holds in both synchronous and asynchronous systems. Second, we show that in synchronous systems algorithms that combine information from different rounds of message exchange can perform better than algorithms that treat each round separately. GRA

N88-23456# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
TOWARDS FULLY ABSTRACT SEMANTICS FOR LOCAL VARIABLES: PRELIMINARY REPORT
Albert R. Meyer and Kurt Sieber Nov. 1987 19 p
(Contract N00014-83-K-0125; Grant NSF DCR-85-11190)

(AD-A191065; MIT/LCS/TM-344) Avail: NTIS HC A03/MF A01 CSCL 12E

The Store Model of Halpern-Meyer-Trakhtenbrot is shown--after suitable repair--to be a fully abstract model for a limited fragment of ALGOL in which procedures do not take procedure parameters. A simple counter-example involving a parameter of program type shows that the model is not fully abstract in general. Previous proof systems for reasoning about procedures are typically sound for the HMT store model, so it follows that theorems about the counter-example are independent of such proof systems. Based on a generalization of standard cpo based models to structures called locally complete partial orders (lcps's), improved models and stronger proof rules are developed to handle such examples. GRA

N88-23457# Ford Aerospace and Communications Corp., Newport Beach, Calif.

FAST ALGORITHM SIMULATION AND TEST (FAST) FACILITY Final Scientific Report, 15 Jul. 1985 - 13 Nov. 1987

R. M. Bieniak, T. G. Gaa, B. K. Harris, and T. L. Rodriguez 13 Nov. 1987 84 p

(Contract DAAL02-85-C-0103)

(AD-A191183) Avail: NTIS HC A05/MF A01 CSCL 20F

This is the final Scientific and Technical Report for the integration of the Field Programmable Algorithm Demonstrator (FPAD) into the Fast Algorithm Simulation and Test (FAST) Facility at the Center for Night Vision and Electro-Optics (CNVEO). This report covers the activity period from July 1985 to November 1987. The primary function of this document is to serve as a comprehensive users guide for all the FPAD FAST application and support software packages. These packages include: Feature Analysis; Image Characteristics: Ground Truthing; Automatic Data Processing; Video Configuration Selection; Frame Number Referencing; NATO Tape Read; and VAX/FPAD Interface. The final five sections of this document describe how to boot the FPAD system, summarizes the algorithms used in the project, identifies the documentation produced, defines the abbreviations used in the document, and provides a cross reference to FAST contract tasks. GRA

N88-23458*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ON 2-D VERSUS 3-D: SINE OF SQUARED ANGULAR ERROR AND WEIGHTED PERPENDICULAR FIXING

Michael W. Rennie 29 Jun. 1987 16 p

(Contract NAS7-918)

(NASA-CR-182899; JPL-D-4611; NAS 1.26:182899; AD-A191185; TM-22) Avail: NTIS HC A03/MF A01 CSCL 09B

If (1) two dimensional algorithms work on variables from a gnomonic plane, and (2) gnomonic planes are based on the same point of tangency both within a single algorithm and between the two and three dimensional algorithms then it is reasonable to ask the question: How much difference does it make if the gnomonic projections are taken before of after fixing. This question will be put into mathematical form and analyzed in this memo. The procedure used will be asymptotic expansion, on the assumption that error would go to zero as the radius of the Earth became infinite if the same gnomonic projected coordinates were involved. In this way the dependence of the difference of projections on the scale restriction is a significant known parameter, best accounted for in this way. For analysis purposes it is also relevant to identify how error models cross to the gnomonic plane. They also may or may not correspond well with two dimensional error models. The two fix techniques being analyzed are the sine of squared angular error and its approximation, the weighted perpendicular. The weighted perpendicular technique is used by the Improved Guardrail V (IGRV) program, and differs from the sine of squared angular error technique in interesting ways that will be discussed later. GRA

N88-23459*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ALGORITHMS AND INTUITION

17 Apr. 1987 15 p

(Contract NAS7-918)

(NASA-CR-182900; JPL-D-4297; NAS 1.26:182900; AD-A191186; TM-9) Avail: NTIS HC A03/MF A01 CSCL 09B

This report describes the Fix Simulation Program available at Mathematical Analysis Research Corp. (MARC, 4329 via Padova, Claremont, Calif. 91711). This program simulates lines-of-bearing (LOB's) between sensors and emitters, subsequent Fix estimation (with several Fix algorithms available), and EEP ellipse generation. Results are displayed on a therminal screen and can be obtained in hard copy on a graphics plotter. Finally, the report describes bias results for all of the available Fix algorithms. GRA

N88-23460# Stanford Univ., Calif. Center for Reliable Computing.

COMPILATION OF PREPRINTS

Aug. 1987 10 p

(Contract N00014-85-K-0600)

(AD-A191245; CRC-TR-87-18; CSL-TN-87-336) Avail: NTIS HC A02/MF A01 CSCL 09A

In part one of this document a new fault model for temporary failures is presented. This model is motivated and supported by recent experimental studies on a type of temporary failure which cannot be explained by existing models. This new fault is called a Byzantine fault in analogy with the well-known Byzantine Generals Problem in distributed systems. Effects of Byzantine faults on concurrent error checking circuits are discussed. Design techniques to eliminate the effects of Byzantine faults are presented. Part two states that one of the major problems in pseudo-exhaustive testing has been the efficient determination of a good circuit segmentation. Two methods of reducing segmentation complexity are presented. The first, Circuit Reduction for Efficient Segmentation (CRES), consists of techniques that reduce a circuit to a smaller circuit that is equivalent under segmentation, as well as heuristic techniques that reduce the circuit complexity further while removing undesirable segmentation points. This smaller, less complex circuit can be used as input to any segmentation algorithm significantly reducing segmentation cost. The results can then be translated into a segmentation of the original circuit. The second method reducing the complexity of segmentation is the use of the maximal fanout-free regions of the circuit as an efficient initial segmentation. These techniques can be used together yielding even greater complexity reductions. GRA

N88-23461# Virginia Univ., Charlottesville. Dept. of Electrical Engineering.

AN ALGORITHM FOR RANDOM ACCESS COMMUNICATION OVER A NOISY CHANNEL Technical Report, 1 Sep. 1986 - 31 Aug. 1988

P. Papantoni-Kazakos 28 Jan. 1988 16 p

(Contract N00014-86-K-0742)

(AD-A191315; UVA/525415/EE88/110) Avail: NTIS HC A02/MF A01 CSCL 25E

We consider synchronous random access systems with noisy transmission channels. We model the channel noise as two types of erroneous feedbacks observed by the users. Specifically, with some probabilities, a successful channel slot and an empty channel slot can be seen as collision slots. For such systems, we analyze the stability conditions of a random access algorithm, both in its full sensing and limited sensing versions. We exhibit the superior resistance of the algorithm to the above feedback errors. GRA

N88-23462# Illinois Univ., Urbana. Coordinated Science Lab.

PIECEWISE LINEAR APPROACH FOR TIMING SIMULATION OF VLSI (VERY-LARGE-SCALE-INTEGRATED) CIRCUITS ON SERIAL AND PARALLEL COMPUTERS Ph.D. Thesis

Ongky Tejayadi Dec. 1987 140 p

(Contract N00014-84-C-0149)

(AD-A191328; UILU-ENG-87-2279; DAC-8) Avail: NTIS HC A07/MF A01 CSCL 20F

The work presented in this report deals with the development of a fast and fairly accurate Computer-Aided Design software for simulating very-large-scale-integrated (VLSI) circuits. The methods

rely on piecewise linearized nonlinear elements in the circuits. The piecewise linear approaches explored in this work are: (1) a fast piecewise linear Gauss-Seidel waveform relaxation method; (2) a slower but more accurate piecewise linear method based on simplices; and (3) a Gauss-Seidel piecewise linear method with dynamic partitioning. Also described is a mixed method which combines the fast piecewise linear method and the dynamic partitioning method. The circuit to be analyzed is partitioned into dc-connected subcircuits and then sequenced for analysis. Small subcircuits are solved using the fast piecewise linear method while large subcircuits, including the strongly connected components in the circuit, are solved using the dynamic partitioning method. A parallel implementation of the Gauss-Seidel piecewise linear method with dynamic partitioning on a uniprocessor computer is studied. Algorithms for the parallel implementation of the dynamic partitioning approach on a multiprocessor with shared memory (Alliant FX/8) are also explained in detail. GRA

N88-23463*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A DESCRIPTION OF AN AUTOMATED DATABASE COMPARISON PROGRAM
John D. McMinn, John D. Shaughnessy, and P. Douglas Arbuckle May 1988 11 p
(NASA-TM-100609; NAS 1.15:100609) Avail: NTIS HC A03/MF A01 CSCL 09B

An interactive FORTRAN computer comparison program designed to automatically locate regions of incongruity between two databases is described. The software, guided by user input parameters, incrementally compares the databases and generates plots of these regions in the databases which do not compare within a specified tolerance. Additionally, tools are provided within the software which enable the user to statistically reduce the number of data points in the databases compared. To facilitate the description of these tools, the procedures used to compare two aerodynamic databases for an F-18A fighter aircraft are detailed. Author

N88-23022# Joint Publications Research Service, Arlington, Va.
STATUS OF CAD/CAM IN MEDIUM-SIZED INDUSTRIES DESCRIBED
In its JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 29-43 Transl. into ENGLISH from Kakai To Kogu (Tokyo, Japan), Jun. 1987 p 113-119 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

N88-23233*# Army Aviation Systems Command, Cleveland, Ohio. Dept. of Civil Engineering.
PARALLEL COMPUTER METHODS FOR EIGENVALUE EXTRACTION
Fred Akl (Ohio Univ., Athens.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 91-102 (For primary document see N88-23226 16-39)
(Grant NAG3-762)
Avail: NTIS HC A20/MF A01 CSCL 09B

N88-23234*# Toledo Univ., Ohio. Dept. of Computer Science and Engineering.
ADAPTING HIGH-LEVEL LANGUAGE PROGRAMS FOR PARALLEL PROCESSING USING DATA FLOW
Hilda M. Standley *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 203-111 (For primary document see N88-23226 16-39)
(Grant NAG3-699)
Avail: NTIS HC A20/MF A01 CSCL 09B

N88-23235*# Sparta, Inc., Huntsville, Ala.
ITERATIVE FINITE ELEMENT SOLVER ON TRANSPUTER NETWORKS
Albert Danial and James Watson *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 113-123 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 09B

N88-23236*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
MULTIPROCESSOR GRAPHICS COMPUTATION AND DISPLAY USING TRANSPUTERS
Graham K. Ellis *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 125-140 Sponsored in part by Space Act Agreement C99066G (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 09B

N88-23258*# Army Aviation Systems Command, Cleveland, Ohio. Structural Dynamics Branch.
PARAFRASE RESTRUCTURING OF FORTRAN CODE FOR PARALLEL PROCESSING
Atul Wadhwa (Sverdrup Technology, Inc., Cleveland, Ohio.) *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 431-447 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 09B

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-23464# Institut National Polytechnique, Grenoble (France).
SIMULATION OF FELIN LOGICS. POLYNOMIALS ROOTS SIMULTANEOUS COMPUTATION ALGORITHMS Ph.D. Thesis [SIMULATION DU FONCTIONNEMENT LOGIQUE DE FELIN. ALGORITHMES DE CALCUL SIMULTANE DE RACINES DE POLYNOMES]
Hassan Ouaouicha 1987 144 p In FRENCH
(ETN-88-92182) Avail: NTIS HC A07/MF A01

The logical simulation of FELIN (integrated elementary functions) mathematical coprocessor is discussed. The method is to implement a circuit architecture simulator where the parallel structures are sequenced by addition of logics components and where the algorithms are executed considering that sequencing. The methods for the simultaneous search of all the roots of a polynomial with complex coefficients are investigated. The study shows that the most efficient is the Durand-Kerner parallel algorithm (Jacobi approach). A parallel architecture adapted to the Durand-Kerner iteration computing is described. ESA

N88-23465# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/Dept. of Interactive Systems.
INTELLIGENT SYSTEMS INTERCONNECTION: WHAT SHOULD COME AFTER OPEN SYSTEMS INTERCONNECTION?
P. Bernus and Z. Letray (Hungarian Academy of Sciences, Budapest.) Sep. 1987 15 p Presented at the 1st Eurographics Workshop on Intelligent CAD Systems, Noordwijkerhout, The Netherlands, Apr. 1987 Submitted for publication
(CWI-CS-R8742; B8735884; ETN-88-92397) Copyright Avail: NTIS Hc A03/MF A01

General architectures for knowledge representation are discussed. A theory of computer-agenthood should describe communication and conversation among agents and the way they interact with the environment. A functional architecture for intelligent systems interconnection is proposed. Subsuming functional layers of representations and theories are identified, without making commitments for particular choices in any one layer. How to bring together represented conscious and unconscious, as well as not represented inherent knowledge, in order to combine intelligence with effectiveness is shown. ESA

N88-23466# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
LOCALITY, COMMUNICATION AND INTERCONNECT LENGTH IN MULTICOMPUTERS
Paul M. B. Vitanyi Sep. 1987 18 p Revised Submitted for publication
(Contracts N00014-85-K-0168; DAAG29-84-K-0058; N00014-83-K-0125; Grant NSF DCR-83-02391)
(CWI-CS-R8743; B8735878; ETN-88-92398) Copyright Avail: NTIS HC A03/MF A01

A lower bound on the average interconnect (edge) length in d-dimensional embeddings of arbitrary graphs, expressed in terms of diameter and symmetry is derived. It is optimal for all graph topologies examined, including complete graph, star, binary n-cube, cube-connected cycles, complete binary tree, and mesh with wrap-around (e.g., torus, ring). The lower bound is technology independent, and shows that many interconnection topologies of multicomputers do not scale well in the physical world (d=2). The proof technique is simple, geometrical, and works for wires with zero volume, e.g., for optical or photonic communication networks. While getting rid of the von Neumann bottleneck in the shift from sequential to nonsequential computation, a communication bottleneck arises because of the interplay between locality of computation, communication, and the number of dimensions of physical space. As a consequence, realistic models for nonsequential computation should charge extra for communication, in terms of time and space. ESA

N88-23467# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science/Dept. of Algorithmics and Architecture.
DISTRIBUTED MATCHMAKING
Sape J. Mullender and Paul M. B. Vitanyi Nov. 1987 28 p Submitted for publication
(Contracts N00014-85-K-0168; DAAG29-84-K-0058; N00014-83-K-0125; Grant NSF DCR-83-02391)
(CWI-CS-R8750; B8735870; ETN-88-92405) Copyright Avail: NTIS HC A03/MF A01

A formal problem called distributed matchmaking is proposed as the generic paradign for control issues in distributed processing. Algorithms for distributed matchmaking are developed and the complexity is investigated in terms of messages and in terms of storage needed. Lower bounds on the complexity of distributed matchmaking are established. Optimal algorithms, or nearly optimal algorithms, are given for particular network topologies. ESA

N88-23468# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
PARALLEL COMPUTING IN COMBINATORIAL OPTIMIZATION
G. A. P. Kindervater and J. K. Lenstra Nov. 1987 36 p Submitted for publication
(CWI-OS-R8720; B8737717; ETN-88-92417) Copyright Avail: NTIS HC A03/MF A01

Literature on parallel computers and algorithms relevant for combinatorial optimization is reviewed. Theoretical and realistic machine models for parallel computations are described. Complexity theory for parallel computations is treated, and resulting concepts are illustrated by presenting polylog parallel algorithms and P-completeness results. The use of parallelism in enumerative methods is considered. ESA

N88-23469# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
DOMAIN DECOMPOSITION IN PARALLEL RESERVOIR SIMULATION
P. H. Michielse 1987 38 p Sponsored by Shell Research B.V., Rijswijk, The Netherlands
(Rept-87-63; B8733843; ISSN-0920-8577; ETN-88-92439)
Copyright Avail: NTIS HC A03/MF A01

A parallelization method based on domain decomposition for numerical oil reservoir simulation, where the concept of local grid refinement, together with a multigrid solver, is used, is discussed. Data structures and implementation aspects are analyzed. Data transfer costs, in case of implementation on a parallel, local memory computer with a low number of processors are estimated. Together with computational costs, this data transfer estimate leads to a parameter study of speed-up factors. ESA

N88-23470# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
POWER SERIES FOR STATIONARY DISTRIBUTIONS OF COUPLED PROCESSOR MODELS
Gerard Hooghiemstra, Michael Keane, and Simon vandeRee 1987 19 p
(Rept-87-70; B8735226; ISSN-0920-8577; ETN-88-92446)
Copyright Avail: NTIS HC A03/MF A01

For the coupled processor model with exponential service times an approach to calculate the stationary distribution of the queue length is presented. The stationary probabilities are expressed as power series in the parameter of the traffic intensity of the system. The method is not restricted to state spaces (of the underlying continuous time Markov chain) of dimension 2, but applies equally well to higher dimensional state spaces. ESA

N88-23471# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
PARALLELIZATION OF GAUSS-SEIDEL ALGORITHMS AS AN EXAMPLE OF PARALLEL ITERATIVE EQUATION SOLVING
L. Dekker 1987 56 p
(Rept-87-76; B8735611; ISSN-0920-8577; ETN-88-92451)
Copyright Avail: NTIS HC A04/MF A01

The parallelization of the point Gauss-Seidel (GS) algorithm is studied for nonlinear equations in the case that the equation solving is done by sequential subtask processing. For subtasks of equal time lengths, like in the linear case, the hardware speed-up sh equals the causal speed-up sc. For nonlinear equations it is analyzed for two synchronization rules under what conditions for the subtask lengths, idle waiting times in the function evaluations can be avoided. The parallelization of the point GS algorithm is studied for linear equations. In sequential equation solving it is discussed how to apply skewed parallel processing for full matrices as well as for band matrices. It is shown that sh, infinity = p and eh, infinity = 1. It is also shown that the speed-up of parallel point GS algorithms can not be more than m as a consequence of the fact that point iterative methods have a low degree of explicity, where m is the number of equations, processed by p = m processors in parallel. The parallelization of the multipoint and block GS algorithms is studied (for linear equations) in order to demonstrate that increase of explicity results in more speed-up. ESA

N88-23472*# Martin Marietta Corp., Denver, Colo.
DIGITAL AVIONICS DESIGN AND RELIABILITY ANALYZER
Feb. 1981 153 p
(Contract NAS1-15780)
(NASA-CR-181641; NAS 1.26:181641) Avail: NTIS HC A08/MF A01 CSCL 09B

The description and specifications for a digital avionics design and reliability analyzer are given. Its basic function is to provide for the simulation and emulation of the various fault-tolerant digital avionic computer designs that are developed. It has been established that hardware emulation at the gate-level will be utilized. The primary benefit of emulation to reliability analysis is the fact that it provides the capability to model a system at a very detailed level. Emulation allows the direct insertion of faults into the system, rather than waiting for actual hardware failures to occur. This allows for controlled and accelerated testing of system reaction to hardware failures. There is a trade study which leads to the decision to specify a two-machine system, including an emulation computer connected to a general-purpose computer. There is also an evaluation of potential computers to serve as the emulation computer. Author

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-23473# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
PARALLEL ARTIFICIAL INTELLIGENCE SEARCH TECHNIQUES FOR REAL TIME APPLICATIONS M.S. Thesis
Donald J. Shakley Dec. 1987 122 p
(AD-A190683; AFIT/GCS/ENG/87D-24) Avail: NTIS HC A06/MF A01 CSCL 12E

State space search is an important component of many problem solving methodologies. The computational models within Artificial Intelligence depend heavily upon state spaces searches. Production systems are one such computational model. Production systems are being explored for real-time environments where timing is of a critical nature. Parallel processing of these systems and in particular concurrent state space searching seems to provide a promising method to increase the performance (effective and efficient) of production systems in the real-time environment. Production systems in the form of expert systems, for example, are being used to govern the intelligent control of the Robotic Air Vehicle (RAV) which is currently a research project at the Air Force Wright Aeronautical Laboratories. Due to the nature of the RAV system, the associated expert system needs to perform in a demanding real-time environment. The use of a parallel processing capability to support the associated computational requirement may be critical in this application. Thus, parallel search algorithms for real-time expert systems are designed, analyzed and synthesized on the Texas Instruments (TI) Explorer and Intel Hypercube. GRA

N88-23474# Technische Hogeschool, Eindhoven (Netherlands).
FEEDBACK DECOUPLING AND STABILIZATION FOR LINEAR SYSTEMS WITH MULTIPLE EXOGENOUS VARIABLES Ph.D. Thesis
Jacob Willem vanderWoude 1987 147 p
(ETN-88-92245) Avail: NTIS HC A07/MF A01

The existence and design of automatic controllers for dynamical systems for which the interaction with the outside world plays an important role are studied. A blender example is used. Disturbance decoupling and output stabilization by measurement feedback with internal stability is considered. The cases of (almost) noninteracting control; (almost) noninteracting control by measurement feedback; and (almost) triangular decoupling are analyzed. ESA

N88-23475# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
CONTRIBUTION TO THE ADAPTIVE DYNAMIC CONTROL OF A ROBOT MANIPULATOR Ph.D. Thesis - Paul Sabatier Univ.
Patricia Conti 1987 175 p In FRENCH; ENGLISH summary
(LAAS-87-350; ETN-88-92008) Avail: NTIS HC A08/MF A01

Position control of robot manipulators is studied. Simple kinematic chain and n revolute and/or prismatic joints are considered. A type of control called dynamic-adaptive is described. It uses a partial dynamic model of the robot manipulator and an adaptive algorithm of the reference model type. The dynamic component compensates for the variations of inertial forces, while the adaptive part compensates for variation of Coriolis and centrifugal forces, friction forces and payload, as well as compensating for modeling and identification errors. A case study for an existing robot manipulator is presented, with a description of the implementation and an analysis of results. ESA

N88-23476# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.
AUTOMATIC CONTROL OF AN INDUSTRIAL PROCESS AND COMPUTER AIDED PROCESS CONTROL BY MEANS OF AN EXPERT SYSTEM Ph.D. Thesis - Paul Sabatier Univ.
Serge Ippolyto 1988 197 p In FRENCH; ENGLISH summary
Sponsored by the Agence Francaise pour la Maitrise de l'Energie, France
(LAAS-88-004; ETN-88-92011) Avail: NTIS HC A09/MF A01

The counter current thermal process used in the ceramic industry was automated in order to improve its performance. A digital control system is implemented to increase energy efficiency taking into account production requirements. The search for the optimal control law is undertaken by an expert system for computer aided process control. It is shown that the knowledge processing transformed by compiling the decision trees allows a reduction of the expert system response time by a factor of 25. ESA

N88-23477# Institut National Polytechnique, Grenoble (France).
PARALLELISM IN A PROLOG KNOWLEDGE BASE MACHINE Ph.D. Thesis [PARALLELISME DANS UNE MACHINE BASE DE CONNAISSANCES PROLOG]
Weidong Dang 1987 169 p In FRENCH; ENGLISH summary
(ETN-88-92187) Avail: NTIS HC A08/MF A01

A Prolog interpretation model based on the notion of process was developed. A process oriented architecture and its implementation in a multiprocessor environment were studied. An experiment using the parallel language OCCAM simulation in order to validate the model is described. A Prolog system based on these ideas, and with the capacity to manipulate clauses in secondary memory is presented. ESA

N88-23478# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
OPTIMAL CONTROL, ESTIMATION COMPENSATION OF LINEAR DISCRETE-TIME SYSTEMS WITH STOCHASTIC PARAMETERS
W. L. deKoning 1987 20 p
(Rept-87-56; B8733837; ISSN-0920-8577; ETN-88-92433)
Copyright Avail: NTIS HC A03/MF A01

The problem of optimal control, estimation, and compensation is considered in the case of linear discrete-time systems with stochastic parameters and quadratic criteria. Descriptive algorithms for the calculation of the different results are given. Representation of parameter uncertainties by stochastic parameters leads automatically to control systems which are inherently robust with respect to parameter variations. Insights to develop the idea of robust control system design with the tool of stochastic parameters are obtained. ESA

N88-23479# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
IDENTIFICATION OF CONTROL STRUCTURES
Cees Witteveen 1987 26 p
(Rept-87-66; B8735222; ISSN-0920-8577; ETN-88-92442)
Copyright Avail: NTIS HC A03/MF A01

Rule based systems with an explicit representation of control structures are considered. Using such a controlled rule based system whose set of rules is assumed to be known, the problem of inferring a control structure from a set of traces produced by the system is addressed. Identification of such a control structure may be important in the building of expert systems or the simplification of such systems. Given a finite class of control structures and distinguishing three identification behaviorally-correct identification, it is shown that the identification methods to be used in these models can be derived from a simple schematic algorithm. ESA

N88-23480# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
CAPITALIZING ON FAILURE THROUGH CASE-BASED INFERENCE Interim Report, Feb. 1986 - Feb. 1987
Janet L. Kolodner Dec. 1987 21 p
(Contract MDA903-86-C-0173; DA Proj. 2Q1-61102-B-74-F)
(AD-A190927; ARI-RN-87-83) Avail: NTIS HC A03/MF A01 CSCL 12E

Previous failures to solve problems can be a powerful aid in helping a problem solver to improve. When prior cases in which

an error was made are recalled (e.g., common sense mediation of everyday disputes and menu planning), the reasoner may consider whether the same potential for error exists in the new case. As a result, reasoning is directed to that part of the current problem that was responsible for the previous error, sometimes changing the problem solver's focus. Focus may also be directed toward gathering knowledge to evaluate the potential for error in the current case. A case with an error may also suggest a correct solution for the new problem. The combination of these helps the problem solver to avoid repeating mistakes and suggests shortcuts in reasoning that avoid the trial and error of previous cases. GRA

N88-23481# Illinois Univ., Urbana. Coordinated Science Lab.
GENERALIZING THE STRUCTURE OF EXPLANATIONS IN EXPLANATION-BASED LEARNING Ph.D. Thesis
Jude W. Shavlik Dec. 1987 291 p
(Contract N00014-86-K-0309; Grant NSF IST-85-11542)
(AD-A191327; UILU-ENG-87-2276) Avail: NTIS HC A13/MF A01 CSCL 23B

Explanation-based learning is a recently developed approach to concept acquisition by computer. In this type of machine learning, a specific problem's solution is generalized into a form that can later be used to solve conceptually similar problems. A number of explanation-based generalization algorithms have been developed. Most do not alter the structure of the explanation of the specific problem - no additional objects nor inference rules are incorporated. Instead, these algorithms generalize by converting constants in the observed example to variables with constraints. However, many important concepts, in order to be properly learned, require that the structure of explanations be generalized. This can involve generalizing such things as the number of entities involved in a concept or the number of times some action is performed. For example, concepts such as momentum and energy conservation apply to arbitrary numbers of physical objects. Clearing the top of a desk can require an arbitrary number of object relocations, and setting a table can involve an arbitrary number of guests. Two theories of extending explanations during the generalization process have been developed, and computer implementations have been created to computationally test these approaches. GRA

N88-23487# Kyushu Univ., Fukuoka (Japan).
REALIZATION OF NATURAL LANGUAGE STYLE ROBOT TASK INSTRUCTION BY USING THE OBJECT ORIENTED CONCEPT
Shigeto Aramaki *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 119-126 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-23482# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
FREE LAPLACIAN WITH ATTRACTIVE BOUNDARY CONDITIONS
H. Englisch, M. Schroeder, and P. Seba 1986 12 p
(DE87-702971; JINR-E-5-86-524) Avail: NTIS (US Sales Only) HC A03/MF A01

The motion of a free quantum particle on the half space R sup n-1 x R sub + is considered. The dependence of surface states on the boundary conditions is investigated and the results are compared with those obtained by a Schroedinger operator with attractive short range potential in the neighborhood of the boundary. It is also shown that for a sufficiently attractive boundary a collapse of the system occurs. DOE

N88-23483# Naval Ship Research and Development Center, Bethesda, Md.
A NEW BLOCK SOLVER FOR LARGE, FULL, UNSYMMETRIC, COMPLEX SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS Final Report
Erwin A. Schroeder Feb. 1988 27 p
(AD-A190590; DTRC-88/003) Avail: NTIS HC A03/MF A01 CSCL 12D

A new block solver, OCSOLVE, for large, full, unsymmetric systems of algebraic equations with complex-valued coefficients has been developed. Although OCSOLVE was developed for use with the finite element program NASTRAN, it is designed to be easily adapted for other applications. This new solver was developed because NASTRAN's solver was not designed to solve full, unsymmetric systems efficiently; it reduced the time required to solve such a system of 500 equations with complex-valued coefficients to about 5% of the time required by the equation solver in NASTRAN. The solver is easily modified to use double precision complex arithmetic on computers on which it is available. With somewhat more effort it could be modified to solve systems of equations having real-valued coefficients. Several features distinguish this linear equation solver from previous solvers. It automatically determines the dimensions of the blocks of coefficients and blocks of right-hand side vectors and avoids the need for adding extra equations by providing for blocks of more than one size. It accepts columns of the coefficient matrix and columns of the right-hand side vectors from a sequential file and returns the columns of solution vectors on a sequential file. The program OCSOLVE will solve with one call, a linear system having multiple right-hand sides. It will solve a system of linear equations if a specified minimum number of words are provided for storing the blocks; however, the more memory provided, and hence the larger blocks, the more efficient the solution will be. GRA

N88-23484# Amsterdam Univ. (Netherlands). Dept. of Computer Science.
SYSTOLIC ALGORITHM FOR MATRIX-VECTOR MULTIPLICATION
W. P. Weijland Mar. 1987 29 p
(PB88-165394; FVI-87-08) Avail: NTIS HC A03/MF A01 CSCL 12A

An algorithm is developed for multiplying a matrix by a vector in the algebraic setting of process algebra. This algorithm was presented earlier by Mead and Conway without introducing a formal language to describe parallelism. The language used is called Algebra of Communicating Processes (ACP), which provides an algebraical description of concurrent processing. A formal proof of correctness of the algorithm is presented. A systolic approach is chosen which says that the final design consists of a large integration of (identical) cells in some regular configuration. Using ACP these cells are allowed to cooperate asynchronously (unlocked) so no external control is needed to make the machine behave as desired. The use of systolic systems turns out to be very helpful for designing VLSI-circuits without loosing grip on and intuition about the behavior of the integrated circuits. GRA

N88-23485# Kyushu Univ., Fukuoka (Japan). Faculty of Engineering.
TECHNOLOGY REPORTS OF KYUSHU UNIVERSITY, VOLUME 61, NO. 2
Mar. 1988 115 p In JAPANESE; ENGLISH summary
(ISSN-0023-2718) Avail: NTIS HC A06/MF A01

Topics addressed include: intrazonal trip distribution model; water wave reflection; urban housing trends; robot task instruction; order determination schemes; timestamp ordering mechanism; complete elliptic integral computation; shock wave/boundary layer interaction; seabed improvement; electrical anisotropy; rolling direction effects on steel sheets; and effect of copper and nickel on steel mechanical properties. For individual titles, see N88-23486 through N88-23490.

N88-23486# Kyushu Univ., Fukuoka (Japan).
A MODEL OF INTRAZONAL TRIP DISTRIBUTION CONSIDERING CENTRALITY INDEX
Takeshi Chishaki, Masaya Kawano, Tetsunobu Yoshitake, and Tokuhiro Amamoto *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 89-94 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

Intrazonal trip distribution (ITD) is discussed in order to find the best constitution of trip distribution. The conventional models of ITD are reviewed on the basis of the technical survey reports on travel demand in several cities. The approach to ITD is proposed to introduce a concept of centrality index. A model of ITD is finally formulated as a multiplicative model including three variables which are centrality index, area of zone and generation or attraction trips. The reproducibility and stability of the proposed model are also investigated by fitting the model to observations of personal trips. Author

N88-23487# Kyushu Univ., Fukuoka (Japan).
REALIZATION OF NATURAL LANGUAGE STYLE ROBOT TASK INSTRUCTION BY USING THE OBJECT ORIENTED CONCEPT **c63**
Shigeto Aramaki *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 119-126 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

It is shown that it becomes easy to translate a natural language style task instruction into the motion level robot program by utilizing the procedures which man can image from the assembly parts. The concept of the object oriented programming is used as a form of the knowledge representation. The operational procedures of the assembly parts and other attributes are constructed by the object oriented model. The translation into the robot program is executed by using the message passing facility of objects. In this translation process, such a task procedure that a bolt is tightened after a washer is placed on, is required. The object, in which the task procedure is described, is prepared in order to raise the modularity of other objects and link easily with a future task planning system. Author

N88-23488# Kyushu Univ., Fukuoka (Japan).
ELECTRICAL ANISOTROPY OF LAYERED SEMICONDUCTOR ZrSe2 **c76**
Xu-guang Zheng, Hisao Kuriyaki, and Kazuyoshi Hirakawa *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 135-139 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

The electric resistivity and the Hall constant of the layered compound ZrSe2 grown by iodine vapor transport method were measured in the temperature range from 77 to 300 K. This compound is found to be an n-type semiconductor with high anisotropy in electric resistivities. The Hall mobility exhibits a temperature dependence of the form mu varies as T sup -1.6. The temperature dependence is well explained in terms of homo-polar-mode optical scattering. Author

N88-23489# Kyushu Univ., Fukuoka (Japan).
A TIMESTAMP ORDERING MECHANISM WITH DYNAMIC SELECTION OF ROLLBACK OBJECTS **c82**
Xingguo Zhong and Yahiko Kambayashi *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 141-148 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

Timestamp ordering approach was considered to be quite suitable for distributed database systems. Experiments, however, have shown that it does not seem to be efficient. In timestamp ordering, conflicts between transactions always occur when a transaction requests an operation on a data item that was operated by another transaction with larger timestamp than that of the requesting transaction. In conventional timestamp ordering mechanisms, when a conflict occurs, the requesting transaction, which is the older transaction with a smaller timestamp, is always rolled back. This is very different from another well-known approach, called 2-phase locking, where the transaction being rolled back can be selected under considering the re-execution cost or other criteria. For this reason, rollback cost is great and partial rollback cannot be realized. A new timestamp ordering mechanism is proposed which rolls back the transaction with the greater timestamp whenever possible. Comparisons among two-phase locking, conventional timestamp ordering mechanisms, and the proposed mechanism are discussed. Author

N88-23490# Kyushu Univ., Fukuoka (Japan).
COMPUTATION OF A COMPLETE ELLIPTIC INTEGRAL OF THE FIRST KIND USING q-EXPANSION
Hideyuki Tamura and Satoru Fukata *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 149-156 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

An algorithm is proposed to extend the computable upper limit of a complete elliptic integral of the first kind, K(m) is approximate to or less than 90 to K(m) is approximate or less than 10 to the 75th, by applying the so-called q-expansion. The restriction K(m) is approximate to or less than 90 is common in the usual computer system and the difficulty is removed by defining a parameter J = (pi/2)K(1 - m)/K(m) instead of the original one (modulus) m. In the present strategy, an algorithm of series operations including the estimations of the upper limit and the standard deviation of the error accumulation in the arithmetic processing, plays a central role, which was proposed. The program of series operations is also demonstrated to be effective, by constructing a purposely complicated procedure to make a series expansion; K(m) = fun(J) of which an exact solution already exists. The relationships between parameters and functions; J, m(new and old), a modified one q = exp (-2J), J sub 1, 1 - m, q sub 1 (their complementary ones), K(m), and K(1 - m), are comprehensively illustrated. Author

N88-23491 Gesellschaft fuer Mathematik und Datenverarbeitung, St. Augustin (West Germany).
A MULTIGRID APPROACH FOR THE SOLUTION OF A NONLINEAR DIFFUSION EQUATION IN A TIME-DEPENDENT AREA USING CARTESIAN COORDINATES [EIN MEHRIGITTERANSATZ ZUR LOESUNG EINER NICHTLINEAREN DIFFUSIONS- GLEICHUNG AUF EINEM ZEITABHAENGIGEN GEBIET UNTER VERWENDUNG KARTESISCHER KOORDINATEN]
Wolfgang Joppich May 1987 57 p In GERMAN (GMD-Studien-122; ISBN-3-88-457122-2; ISSN-0170-8120; ETN-88-91433) Copyright Avail: Fachinformationszentrum Karslruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

Charge carrier distributions in semiconductor material were calculated by solving the occurring nonlinear diffusion equation using a multigrid approach. This problem is an important element in the numerical process simulations in VLSI techniques. The calculation was performed without area transformation to the original area, and using Cartesian coordinates. The local discretization was made in a rectangular grid, equidistant in both coordinate directions. The boundary conditions were partly eliminated (homogeneous Neumann boundary condition) and partly treated separately (nonlinear boundary condition on the moving boundary). The application of the multigrid technique in combination with a time marching method was possible using an implicit time discretization. ESA

N88-23492# Technische Hogeschool, Eindhoven (Netherlands).
EXPERIMENTAL DESIGN AND STRUCTURAL OPTIMIZATION Ph.D. Thesis
Albertus Johannes Ge Shoofs 1987 140 p
(ETN-88-92232) Avail: NTIS HC A07/MF A01

A structural design method integrating finite element methods (FEM) and mathematical programming is described. The FEM-analyses to be carried out are a priori planned, concerning their number and the values of the relevant design variables. From the outcomes of the computations an approximating mathematical model is derived by means of regression analysis. The derived models are linear in the parameters; mostly polynomial models are used. For the planning of the FEM-computations and for the analysis of the outcomes, experiment design theory is applied. The FEM-computations can be considered numerical experiments and can be used to establish a numerical experimental design, to derive an efficient mathematical model of the structure under consideration. The methods were used for the shape optimization of church and carillon bells, resulting in musically very interesting bell types. The methods were also applied successfully to mechanical engineering problems and to a biomechanical problem. ESA

N88-23493# Technische Hogeschool, Eindhoven (Netherlands).
CONTINUOUS DECOUPLING TRANSFORMATIONS FOR LINEAR BOUNDARY VALUE PROBLEMS Ph.D. Thesis
Paul Marie vanLoon 1987 221 p
(ETN-88-92248) Avail: NTIS HC A10/MF A01

Systems of linear boundary value problems (BVPs) for ordinary differential equations are studied, emphasizing solution methods for BVPs based on the integration of initial value problems (IVPs), like (multiple) shooting techniques. The main problem to evade arises from the fact that a BVP may have both (fast) increasing and (fast) decaying modes. Problems can be circumvented by a continuous decoupling of the (fast) increasing and the (fast) decaying modes. Such a decoupling can be interpreted as a transformation that actually accounts for the direction of the fastest increasing (called dominant) modes. The growth of these modes can be determined separately. For this technique only well-conditioned IVPs the solution of which are slowly varying or fast decaying have to be solved. The price to be paid is that some of these IVPs are nonlinear. A generalized invariant imbedding technique which is not necessarily related to the Riccati (decoupling) transformation, is suggested. The resulting technique, which involves forward integration only, is similar to a backward integration, after the dominant modes are decoupled. ESA

N88-23494# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Traegheitsortung und Navigation.
NEW STABLE, VECTORISABLE KALMAN FILTER ALGORITHMS BASED ON ORTHOGONAL TRANSFORMATIONS Ph.D. Thesis - Technische Univ., Brunswick, Fed. Republic of Germany
Hans-Juergen Hotop Dec. 1987 210 p In GERMAN; ENGLISH summary Report will also be announced as translation (ESA-TT-1108)
(DFVLR-FB-87-52; ISSN-0171-1342; ETN-88-92324) Avail: NTIS HC A10/MF A01; DFVLR, VB-PL-DO, 90 60 58, 5000 Cologne, Fed. Republic of Germany, 68 DM

A stable Kalman filter algorithm based on a Givens transformation is developed theoretically together with three separate update formulations. The backward filter of Rauch-Tung-Striebel is reformulated. As an alternative orthogonal transformation the singular value decomposition is investigated. The advantage of the Kalman filter algorithm vs. conventional formulations is examined for the support of inertial navigation systems (simulation and flight data) on serial computers and a vector processor. ESA

N88-23495# Grenoble-1 Univ. (France).
FORMAL SOLUTION OF DIFFERENTIAL LINEAR SYSTEMS IN THE PROXIMITY OF A SINGULARITY Ph.D. Thesis [SOLUTIONS FORMELLES DE SYSTEMES DIFFERENTIELS LINEAIRES AU VOISINAGE D UN POINT SINGULIER]
Abdelaziz Hilali 1987 297 p In FRENCH
(ETN-88-92190) Avail: NTIS HC A13/MF A01

Reduction systems where the coefficients are formal series are proposed. The method includes the characterization of the singularity and the transformations which allow the solution of the equations. A generalization of the reduction algorithm and of the Moser criterium is presented. The analysis leads to the implementation of a general algorithm for obtaining formal solutions in the proximity of a singularity. ESA

N88-23496# Grenoble-1 Univ. (France).
APPROXIMATION AND REPRESENTATION OF EXPLICIT SURFACES IN THE PRESENCE OF SINGULARITIES Ph.D.Thesis [SUR L APPROXIMATION ET LA REPRESENTATION DE SURFACES EXPLICITES EN PRESENCE DE SINGULARITES]
Pascal Klein 1987 140 p In FRENCH
(ETN-88-92191) Avail: NTIS HC A07/MF A01

Algorithms to approximate and to represent explicit surfaces in the presence of singularities are presented. The singularities are discontinuities with a finite jump in value or derivative. Convolution spline theory is used to develop the algorithms. Another algorithm able to design the equal value lines for that type of surface is also presented. A computer program including several algorithms referring to explicit surfaces is described. ESA

N88-23497# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
MATHEMATICAL MORPHOLOGY: AN ALGEBRAIC APPROACH
H. J. A. M. Heijmans Sep. 1987 19 p
(CWI-AM-R8707; B8735761; ETN-88-92390) Copyright Avail: NTIS HC A03/MF A01

The basic transformations of mathematical morphology, namely dilation, erosion, closing, and opening are explained. The step from the continuous to the discrete space, involving the digitalization of images, can be justified if one can supply the continuous object space (whose elements are sets) with a topology. The introduction of a topology also enables one to prove robustness of transformations. An abstract definition of dilation and erosion which depends on the choice of a commutative automorphism group on the lattice is given. An abstract version of Matheron's (1975) theory that every increasing translation invariant transformation can be written as an intersection of dilations, or equivalently, as a union of erosions is proved. ESA

N88-23498# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
JACOBI POLYNOMIALS AS GENERALIZED FABER POLYNOMIALS
Ahmed I. Zayed (California Polytechnic State Univ., San Luis Obispo.) Sep. 1987 17 p Submitted for publication
(CWI-PM-R8706; B8735757; ETN-88-92391) Copyright Avail: NTIS HC A03/MF A01

The open bounded subset B of the complex z-plane with closure B bar whose complement is a simply connected domain on the Riemann sphere is considered. The generalized Faber polynomials of B are defined and it is shown that if the Jacobi polynomials are generalized Faber polynomials of any region B, then it must be an elliptic region, which is defined. The only Jacobi polynomials that can be classified as generalized Faber polynomials are the Chebyshev polynomials of the first kind, normalized Gegenbauer polynomials, normalized Jacobi polynomials and there are no others, no matter how one normalizes them. The Hermite and Laguerre polynomials can not be generalized Faber polynomials of any region. ESA

N88-23499# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Computer Science.
READINESS AND FAILURES IN THE ALGEBRA OF COMMUNICATING PROCESSES
J. A. Bergstra, J. W. Klop, and E.-R. Olderog (Kiel Univ., West Germany) Oct. 1987 57 p Revised
(CWI-CS-R8748; ETN-88-92403; B8735886) Copyright Avail: NTIS HC A04/MF A01

Readiness and failure semantics are studied in the setting of ACP (Algebra of Communicating Processes). A model of process

graphs modulo readiness equivalence, respectively failure equivalence, is constructed, and an equational axiom system which is complete for this graph model is presented. An explicit representation of the graph model, the failure model, whose elements are failure sets is given. A characterization of failure equivalence is obtained as the maximal congruence which is consistent with trace semantics. By suitably restricting the communication format in ACP, this result is shown to carry over to subsets of Hoare's CSP and Milner's CCS. The characterization implies a full abstraction result for the failure model. Analysis is restricted to finite processes without tau steps. The situation for infinite processes with tau steps is also considered. It is shown that failure semantics is incompatible with Koomen's fair abstraction rule, a proof principle based on the notion of bisimulation. This is remarkable because a weaker version of Koomen's fair abstraction rule is consistent with (finite) failure semantics. ESA

N88-23500# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
RESIDUAL SMOOTHING FOR ACCELERATING THE ALTERNATING DIRECTION IMPLICIT (ADI) ITERATION METHOD FOR ELLIPTIC DIFFERENCE EQUATIONS
J. H. M. tenThijeBoonkkamp Nov. 1987 17 p Submitted for publication
(CWI-NM-R8721; B8735877; ETN-88-92411) Copyright Avail: NTIS HC A03/MF A01

Residual smoothing is combined with the ADI iteration method, to reduce the number of iterations and thus the computing time of the ADI scheme. The parameter values of the smoothed ADI scheme are chosen such that the high and low frequency components in the iteration error are damped very well. Due to the residual smoothing, the other components in the error are also properly damped. Numerical examples demonstrate the performance results of the ADI scheme and the smoothed ADI scheme. ESA

N88-23501# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
AN INNOVATION APPROACH TO GOODNESS OF FIT TESTS IN R SUP m
E. V. Khmaladze Nov. 1987 15 p
(CWI-MS-R8712; B8737712; ETN-88-92412) Copyright Avail: NTIS HC A03/MF A01

A solution to the goodness-of-fit problem for multivariate observations, using the innovation process for the (sequential) empirical distribution function with respect to a conveniently chosen linear ordering or scanning system in R sup m is presented. ESA

N88-23502# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
SPECTRAL ANALYSIS IN THE LINEAR GEODETIC BOUNDARY VALUE PROBLEM Thesis [SPECTRALE FOUTSCHATTING IN HET LINEAIR GEODETISCH RANDVOORWAARDE PROBLEM]
Martin vanGelderen Feb. 1987 81 p
(B8735056; ETN-88-92427) Avail: NTIS HC A05/MF A01

The properties and the spherical expansion of isotropical (azimuth independent) functions are discussed. It is shown, in comparison with 1D-Fourier, that integral operators like the Stokes operator are convolution integrals. The differences between stochastical and empirical covariances; the meaning of degree variances and models for them; and two noise models are discussed: white noise and colored noise with the Krarup kernel. The estimation of accuracies and resolutions by models for the power spectra is considered. When integrations like the Stokes integral are carried out over a limited area instead of over the entire sphere, this introduces a truncation error in the geoid height which can be estimated by a degree variance model for the gravity anomalies and the Moloneskii Q-coefficients. When the truncation error is plotted as function of the truncation distance two local minima occur. For this strange effect no good explanation is found. ESA

N88-23503# Technische Hogeschool, Delft (Netherlands). Dept. of Geodesy.
THE 1 AND 2D SYMMETRIC HELMERT TRANSFORMATION: AN EXACT NONLINEAR LEAST SQUARES SOLUTION
Peter J. G. Teunissen 1987 29 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(Rept-87-1; B8736713; ETN-88-92430) Copyright Avail: NTIS HC A03/MF A01

A class of nonlinear least squares problems for which it is possible to take advantage of the special structure of the nonlinear model is discussed. The nonlinear models are manifolds of the ruled-type (Teunissen, 1985). The proposed solution strategy for this class of problems is applied to the 1 and 2D nonlinear symmetric Helmert transformation. Exact nonlinear least squares solutions are derived. ESA

N88-23504# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
ORTHOGONAL POLYNOMIALS WITH RESPECT TO A SYMMETRIC INNER PRODUCT INVOLVING DERIVATES
H. Bavinck and H. J. Meijer 1987 24 p
(Rept-87-59; B8733839; ISSN-0920-8577; ETN-88-92435)
Copyright Avail: NTIS HC A03/MF A01

Orthogonal polynomials with respect to an inner product which cannot be obtained by a weight function are analyzed. ESA

N88-23505# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
CONVERGENCE QUALIFICATION OF PARTITION ALGORITHMS IN GLOBAL OPTIMIZATION
Janos Pinter (Research Inst. for Water Resources Development, Budapest, Hungary) 1987 29 p
(Rept-87-61; B8733841; ISSN-0920-8577; ETN-88-92437)
Copyright Avail: NTIS HC A03/MF A01

A partition algorithm scheme for global (complete) search in optimization problems is presented, and necessary and sufficient convergence conditions are formulated in terms of respectively implied or postulated features of the partition operator. The convergence results obtained are pertinent to a number of deterministic methods in multiextremal optimization; they also provide a flexible framework for constructing convergent algorithms. ESA

N88-23506# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
A PRACTICAL TERMINATION CRITERION FOR THE CONJUGATE GRADIENT METHOD
E. F. Kaasschieter 1987 27 p
(Rept-87-62; B8733842; ISSN-0920-8577; ETN-88-92438)
Copyright Avail: NTIS HC A03/MF A01

It is shown that the conjugate gradient method for the iterative solution of a set of linear equations $Ax = b$ is essentially equivalent to the Lanczos method, which implies that approximations to certain eigenvalues of A can be obtained at low costs. It is shown how the smallest active eigenvalue of A can be cheaply approximated, and the usefulness of this approximation for a practical termination criterion for the conjugate gradient method is studied. It is proved that this termination criterion is reliable in many relevant situations. ESA

N88-23507# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
AN ALGEBRAIC CONSTRUCTION OF A CLASS OF ONE-DEPENDENT PROCESSES
Jon Aaronson, David Gilat (Tel-Aviv Univ., Israel), Michael Keane, and Vincent deValk 1987 22 p Sponsored by the Netherlands Foundation for Mathematics and the Netherlands Organization for the Advancement of Pure Research
(Rept-87-65; B8733845; ISSN-0920-8577; ETN-88-92441)
Copyright Avail: NTIS HC A03/MF A01

A class of stationary one-dependent two-valued stochastic processes is defined. Two parameter values are associated to each member of this class, whereby different members receive

parameter values. For any given values of the parameters, it is shown how to determine whether a process exists having the given parameter values, and if so, this process can be obtained as a two-block factor from an independent process. This determines a two-parameter subfamily of the class of stationary one-dependent two valued stochastic processes which are not two-block factors of independent processes. ESA

N88-23508# Vrije Universiteit, Amsterdam (Netherlands). Subfaculteit Wiskunde en Informatica.
UNIQUE NORMAL FORMS FOR LAMBDA CALCULUS WITH SURJECTIVE PAIRING
J. W. Klop and R. C. deVrijer Sep. 1987 19 p
(PB88-173539; Rept-132) Avail: NTIS HC A03/MF A01 CSCL 12A

The equational theory lambda pi of pi-calculus extended with constants pi, pi(0), pi(1) and axioms for surjective pairing is considered: pi(0)(piXY) = X, pi(1)(piXY)=Y, pi(pi(0)X)(pi(1)X) = X. Two reduction systems yielding the equality of lambda pi, are introduced; the first is not confluent and for the second confluence is an open problem. It is shown however, that in both systems each term possessing a normal form has a unique normal form. Some additional properties and problems in the syntactical analysis of lambda pi and the corresponding reduction systems are discussed. Author

N88-23509# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
ON 1/n-EXPANSION AND WAVE FUNCTIONS
V. D. Mur, S. G. Pozdnyakov, and V. S. Popov 1987 24 p In RUSSIAN
(DE88-701639; ITEF-122(1987)) Avail: NTIS (US Sales Only) HC A03/MF A01

The 1/n expansion is applied to the calculation of wave functions. Analytical formulae, true for arbitrary smooth potential V(r) including the coefficients determining the behavior of wave function X(sub e)(r) at r yields 0 and r yields infinity, were derived. An approximate formula for effective radius r(sub e) at the moment of appearance of related l-level (E=0) was derived as well. These formulae are asymptotically accurate at l yields infinity. Comparison with numerical calculations (for power potentials, funnel and Yukawa potential) shows that the applicability area is expanded up to low l(sub s). DOE

N88-23510*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN APPROXIMATION THEORY FOR THE IDENTIFICATION OF NONLINEAR DISTRIBUTED PARAMETER SYSTEMS Final Report
H. T. Banks, Simeon Reich, and I. G. Rosen (University of Southern California, Los Angeles.) Apr. 1988 39 p Prepared in cooperation with Technion - Israel Inst. of Tech., Haifa Sponsored in part by Technion - Israel VPR Fund Submitted for publication
(Contract NAS1-18107; Grant NAG1-517)
(NASA-CR-181658; ICASE-88-26; NAS 1.26:181658) Avail: NTIS HC A03/MF A01 CSCL 12A

An abstract approximation framework for the identification of nonlinear distributed parameter systems is developed. Inverse problems for nonlinear systems governed by strongly maximal monotone operators (satisfying a mild continuous dependence condition with respect to the unknown parameters to be identified) are treated. Convergence of Galerkin approximations and the corresponding solutions of finite dimensional approximating identification problems to a solution of the original finite dimensional identification problem is demonstrated using the theory of nonlinear evolution systems and a nonlinear analog of the Trotter-Kato approximation result for semigroups of bounded linear operators. The nonlinear theory developed here is shown to subsume an existing linear theory as a special case. It is also shown to be applicable to a broad class of nonlinear elliptic operators and the corresponding nonlinear parabolic partial differential equations to which they lead. An application of the theory to a quasilinear model for heat conduction or mass transfer is discussed. Author

N88-23511# Naval Postgraduate School, Monterey, Calif.
BAYESIAN SOLUTIONS TO A 2 X 2 DECISION MATRIX USING INTERVAL SCALED PAYOFFS WITH AN APPLICATION TO FOREIGN POLICY DECISIONS M.S. Thesis
Alan R. King Sep. 1987 65 p
(AD-A190863) Avail: NTIS HC A04/MF A01 CSCL 12C

Statistical Design Theory is applied to assessing objectively the uncertainty involved in foreign policy decisions. In an international conflict of interest situation, a protagonist is presented with the problem of estimating what course of action an antagonist is going to pursue. This problem is addressed by taking observations of the antagonist's behavior. These observations are interpreted as being associated with a specific course of action. Bayes formula is then used to update a conjectured a prior probability function to estimate the course of action being pursued by the antagonist. This updated (a posteriori) conditional probability function is then used to develop a decision rule to select an appropriate response. The decision rule is based on an ordering of possible outcomes, the values assigned to those outcomes, and greatest expected value of return. GRA

N88-23512# North Carolina State Univ., Raleigh. Center for Research in Scientific Computation.
SOLVING SINGULAR SYSTEMS USING ORTHOGONAL FUNCTIONS
Stephen L. Campbell and Kevin D. Yeomans 8 Oct. 1987 10 p
(Grants AF-AFOSR-0051-87; NSF DME-86-13093)
(AD-A190881; CRSC-TR-100587-01; AFOSR-87-1977TR) Avail: NTIS HC A02/MF A01 CSCL 12A

Orthogonal functions, and in particular, Walsh functions, have been advocated in the literature as a method of approximating the solutions of singular systems Ex' = Fx + Bu of index k. This paper gives the first analysis of the accuracy of these approximations. For Walsh functions, divergence is shown for k greater than or = 3 and convergence for k = 0.1. The index two case is also analyzed. GRA

N88-23513# North Carolina State Univ., Raleigh. Center for Research in Scientific Computation.
DERIVATIVE ARRAYS, GEOMETRIC CONTROL THEORY AND REALIZATIONS OF LINEAR DESCRIPTOR SYSTEMS
Stephen L. Campbell and William J. Terrell 24 Nov. 1987 15 p
(Grants AF-AFOSR-0051-87; NSF DMS-86-13093)
(AD-A190882; CRSC-TR-112587-01; AFOSR-87-1975TR) Avail: NTIS HC A03/MF A01 CSCL 12B

The relationship between numerical methods for realizations of E(t)x'(t) + F(t)x(t)=f(t) based on derivative arrays and geometric control realization procedures based on Lie derivatives is examined. GRA

N88-23514# Houston Univ., Tex. Dept. of Mathematics.
RESEARCH IN NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS AND BIFURCATION THEORY Final Report, 15 Jul. 1986 - 14 Oct. 1987
David H. Wagner 22 Dec. 1987 29 p
(Grant AF-AFOSR-0218-86)
(AD-A190986; AFOSR-88-0087TR) Avail: NTIS HC A03/MF A01 CSCL 07D

We prove a necessary condition and a sufficient condition for the existence of steady plane wave solutions to the Navier Stokes equations for a reacting gas. These solutions represent plane detonation waves, and converge to ZND detonation waves as the viscosity, heat conductivity, and species diffusion rates tend to zero. We assume that the Prandtl number is 3/4, but we permit arbitrary Lewis numbers. We make no assumption concerning the activation energy. We show that the stagnation enthalpy and the entropy flux are always monotone for such solutions, and that the mass density and pressure are nearly always not monotone, as predicted by the ZND theory. In certain parameter ranges, typically

that of large diffusion, many of these waves have the appearance of a weak detonation followed by an inert shock wave. This confirms a phenomenon observed in numerical calculations and in a model system by Colella, Majda, and Roytburd. GRA

N88-23515# Naval Research Lab., Washington, D.C.
INCOMPLETE LIPSCHITZ-HANKEL INTEGRALS OF MACDONALD FUNCTIONS Final Report, Jan. - May 1987
Allen R. Miller 15 Mar. 1988 14 p
(AD-A191034; NRL-9112) Avail: NTIS HC A03/MF A01 CSCL 12A

Various representations for incomplete Lipschitz-Hankel integrals of MacDonald functions have been given in closed form using Kampe de Feriet double hypergeometric functions. In addition, reduction formulas for the Kampe de Feriet functions associated with these integrals have been derived in some cases. GRA

N88-23516# Maryland Univ., College Park. Dept. of Mathematics.
PARTIAL LIKELIHOOD ANALYSIS OF TIME SERIES MODELS WITH APPLICATION TO RAINFALL-RUNOFF DATA
Eric V. Slud and Benjamin Kedem 25 Feb. 1988 25 p
(Contract N00014-86-K-0007)
(AD-A191157; TR-88-11; MD88-11-ES/BK) Avail: NTIS HC A03/MF A01 CSCL 12A

A general logistic-autoregressive model for binary time series or longitudinal responses is presented, generalizing the discrete-time Cox (1972) model with time-dependent covariates as well as the recent regression models of Kaufmann (1987) for categorical time-series. Since this model is formulated in terms of the time-series covariates which are not themselves explicitly modelled, the large-sample theory of parameter-estimation must be justified by means of Partial Likelihood in the sense of Cox (1975), using theoretical results like those of Wong (1986). The large-sample theory also justifies goodness of fit tests analogous to the chi-squared tests of Schoenfeld (1980) and to the tests based on sums of (normalized) squared residuals used in logistic regression. These ideas are illustrated by analysis of a rainfall-runoff hydrological dataset previously analyzed by Yakowitz (1987). GRA

N88-23517# George Mason Univ., Fairfax, Va. Dept. of Operations Research and Applied Statisti cs.
A NOTE ON PHASE-TYPE, ALMOST PHASE-TYPE, GENERALIZED HYPEREXPONENTIAL AND COXIAN DISTRIBUTION, REVISION
Carl M. Harris and Robert F. Botta Jan. 1988 13 p
(Contract N00014-86-K-0029)
(AD-A191236; GMU/22461/102-Rev) Avail: NTIS HC A03/MF A01 CSCL 12C

This note updates earlier results on how various types of Coxian distributions relate to each other. Some more recent uses of such distributions are discussed, with an emphasis on their connection to generalized hyperexponential distributions. Particular attention is paid to the class of densities having Laplace transforms with only real negative zeros and poles and their relationship with the GH class. GRA

N88-23518# Washington Univ., Seattle. Dept. of Statistics.
LEAVE-K-OUT DIAGNOSTICS FOR TIME SERIES
Andrew G. Bruce and R. D. Martin Sep. 1987 93 p
(Contract N00014-84-C-0169)
(AD-A191343; TR-107) Avail: NTIS HC A05/MF A01 CSCL 12C

The authors propose diagnostics for ARIMA model fitting for time series formed by deleting observations from the data and measuring the change in the estimates of the parameters. The use of leave-one out diagnostics is a well established tool in regression analysis. This document demonstrates the efficacy of observation deletion based diagnostics for ARIMA models, addressing issues special to the time diagnostics based on the innovations variance. It is shown that the dependency aspect of time series data gives rise to a smearing effect, which confounds the diagnostics for the coefficients. It is also shown that the diagnostics based on the innovations variance are much clearer and more sensitive than those for the coefficients. A leave-k-out diagnostics approach is proposed to deal with patches of outliers, and problems caused by masking are handled by use of iterative deletion. An overall strategy for ARIMA model fitting is given, and applied to two data sets. GRA

N88-23519*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACCURACY VERSUS CONVERGENCE RATES FOR A THREE DIMENSIONAL MULTISTAGE EULER CODE Final Report
Eli Turkel (Tel-Aviv Univ., Israel) May 1988 21 p Presented at the 16th ICAS Congress, Jerusalem, Israel
(Contract NAS1-18107)
(NASA-CR-181665; ICASE-88-30; NAS 1.26:181665) Avail: NTIS HC A03/MF A01 CSCL 12A

Using a central difference scheme, it is necessary to add an artificial viscosity in order to reach a steady state. This viscosity usually consists of a linear fourth difference to eliminate odd-even oscillations and a nonlinear second difference to suppress oscillations in the neighborhood of steep gradients. There are free constants in these differences. As one increases the artificial viscosity, the high modes are dissipated more and the scheme converges more rapidly. However, this higher level of viscosity smooths the shocks and eliminates other features of the flow. Thus, there is a conflict between the requirements of accuracy and efficiency. Examples are presented for a variety of three-dimensional inviscid solutions over isolated wings. Author

N88-23252*# Michigan Univ., Ann Arbor.
MIXED FINITE ELEMENT FORMULATION APPLIED TO SHAPE OPTIMIZATION
Helder Rodrigues, John E. Taylor, and Noboru Kikuchi *In* NASA, Lewis Research Center, Lewis Structures Technology, 1988. Volume 1: Structural Dynamics May 1988 p 353-365 (For primary document see N88-23226 16-39)
Avail: NTIS HC A20/MF A01 CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-23520# Fraunhofer Inst. fuer Werkstoffmechanik, Freiburg (West Germany).
APPLICABILITY AND LIMITATIONS OF PROBABILITY MODELS IN CONNECTION WITH THE RELIABILITY OF LARGE-SCALE TECHNICAL INSTALLATIONS Final Report [EINSATZMOEGLICHKEITEN UND GRENZEN VON PROBABILISTISCHEN MODELLEN IM ZUSAMMENHANG MIT DER ZUVERLAESSIGKEIT GROSSTECHNISCHER ANLAGEN]
W. Schmitt, E. Baudendistel, and A. Ockewitz Mar. 1987 61 p In GERMAN
(Contract BMFT-1500637A)
(W-3/87; ETN-88-91462) Avail: NTIS HC A04/MF A01

The deterministic and probabilistic fracture mechanics code OCA-P was improved and modified with a view to reliability predictions for arbitrary geometries. The comparison of the results obtained with the new routines agree satisfactorily with those of the original version, within the framework of analytical methods. A special plot software was developed, providing possibilities for on-line plots. Finite element simulation calculations were performed to model the mesostructure of materials. It is shown that existing material models do not allow a complete modeling. ESA

N88-23521# Technische Hogeschool, Delft (Netherlands).
FAULT TREE ANALYSIS AND SYNTHESIS Ph.D. Thesis
Adrianus Bossche 1987 176 p
(ETN-88-92236) Avail: NTIS HC A09/MF A01

The Top-Event's Frequency Algorithm for evaluating the top-event's failure frequency of fault trees containing mutually

exclusive failure modes of multi-state components is derived. The System Interstate Frequency Algorithm to evaluate the state probabilities and interstate frequencies of a (sub)system from which the (sub)system's transition rates can be found easily is introduced. This latter algorithm allows a recursive calculation of system state frequencies and transition rates, i.e., the probability and frequency data of subsystem performance are calculated prior to the evaluation of the probability and frequency data of the system using the same algorithm for all steps. Component models that show all fault propagation through the components and fault initiation by the components in both directions (upstream and downstream) are outlined. It is shown how to create system models that interconnect system components and environmental variables. A fault tree construction algorithm to generate fault trees from the given system and component models is presented. A real-time fault location algorithm to extract all faults and fault combinations that are most consistent with the set of measured variables, even when sensor circuits provide faulty information, is shown. ESA

N88-23522# Technische Hogeschool, Eindhoven (Netherlands).
ANALYSIS OF MEANS IN SOME NONSTANDARD SITUATIONS Ph.D. Thesis
Jan Boudewijn Dijkstra 1987 131 p
(ETN-88-92247) Avail: NTIS HC A07/MF A01

Testing the equality of several means when the population variances are unequal; using the Kruskal and Wallis test with normal distributions and unequal variances; nonparametric comparison of several mean values with adaptation to the tail-weights; comparison of several mean values in the presence of outliers; and robustness of multiple comparisons against variance heterogeneity and outliers are discussed. ESA

N88-23523# Grenoble-1 Univ. (France).
STOCHASTIC APPROACH OF IMAGE SEGMENTATION. A MODEL OF COOPERATION BETWEEN REGION PRIMITIVES AND BOUNDARIES Ph.D. Thesis [APPROCHE STOCHASTIQUE DE LA SEGMENTATION DES IMAGES: UN MODELE DE COOPERTION ENTRE LES PRIMITIVES DE REGIONS ET DE FRONTIERES]
Saida Bouakaz 1987 169 p In FRENCH
(ETN-88-92192) Avail: NTIS HC A08/MF A01

An image segmentation method based on stochastic labeling is presented. The iterative stochastic approach allows the simultaneous treatment of the classical frontier and region models in a single process. Each point is assigned at its labeling vector level region type and frontier type data. The presented image examples confirm the efficacity of the method. ESA

N88-23524# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
INTRODUCTION TO NILPOTENT APPROXIMATION FILTERING
Michiel Hazewinkel Nov. 1987 9 p
(CWI-PM-R8709; B8735759; ETN-88-92393) Copyright Avail: NTIS HC A02/MF A01

Research on nilpotent approximation filtering is outlined. The socalled reference probability of unnormalized probability method for nonlinear filtering problems leads to a (robust) infinite dimensional filter of bilinear type. If the associated Lie algebra is topologically solvable or nilpotent an infinite dimensional version of Wei-Norman theory applies. If not, then ideas of nilpotent approximation lead to (potential) approximation filters. ESA

N88-23525# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Mathematical Statistics.
A CENTRAL LIMIT THEOREM FOR M-ESTIMATORS BY THE VON MISES METHOD
C. C. Heesterman Nov. 1987 16 p
(CWI-MS-R8713; B8737713; ETN-88-92413) Copyright Avail: NTIS HC A03/MF A01

The asymptotic normality of maximum likelihood type estimators (Huber, 1967) is considered. Reeds (1976) argued that this could also be established as an application of the delta method, using the tool of compactly differentiating von Mises functionals with respect to the (empirical) distribution function Fn. If slightly adapted, this alternative approach is shown to be quite fruitful, maybe even in the nonparametric case. A corrected version of the proof by Reeds is given. ESA

N88-23526*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE PAWS AND STEM RELIABILITY ANALYSIS PROGRAMS
Ricky W. Butler and Philip H. Stevenson (Planning Research Corp., Hampton, Va.) Mar. 1988 45 p
(NASA-TM-100572; NAS 1.15:100572) Avail: NTIS HC A03/MF A01 CSCL 12A

The PAWS and STEM programs are new design/validation tools. These programs provide a flexible, user-friendly, language-based interface for the input of Markov models describing the behavior of fault-tolerant computer systems. These programs produce exact solutions of the probability of system failure and provide a conservative estimate of the number of significant digits in the solution. PAWS uses a Pade approximation as a solution technique; STEM uses a Taylor series as a solution technique. Both programs have the capability to solve numerically stiff models. PAWS and STEM possess complementary properties with regard to their input space; and, an additional strength of these programs is that they accept input compatible with the SURE program. If used in conjunction with SURE, PAWS and STEM provide a powerful suite of programs to analyze the reliability of fault-tolerant computer systems. Author

N88-23527# Florida State Univ., Tallahassee. Dept. of Statistics.
INFERENCE FOR A NONLINEAR SEMIMARTINGALE REGRESSION MODEL
Ian W. McKeague and Klaus J. Utikal Nov. 1987 25 p
(Contracts DAAL03-86-K-0094; F49620-85-C-0007)
(AD-A190857; FSU-TR-M-770; TR-D-98-ARO) Avail: NTIS HC A03/MF A01 CSCL 12C

This document considers a semimartingale regression model where Y, Z are observable covariate processes alpha is a (deterministic) function of both, time and the covariate process Z, and M is a square integrable martingale. Under the assumption that i.i.d. copies of X, Y, Z are observed continuously over a finite time interval, inference for the function alpha (t, z) is investigated. An estimator A (caret) for the time integrated alpha (t, z) and a kernel estimator of alpha (t, z) itself for introduced. For X a counting process, A (caret) reduces to the Nelson-Aalen estimator when Z is not present in the model. Various forms of consistency are proved, rates of convergence and asymptotic distributions of the estimators are derived. Asymptotic confidence bands for the time integrated alpha (t, z) and a Kolmogorov-Smirnov-type test of equality of alpha at different levels of the covariate are given. GRA

N88-23528# Texas Univ., Arlington. Coll. of Engineering.
DEVELOPMENT OF ADAPTIVE GRID SCHEMES BASED ON POISSON GRID GENERATORS Annual Report, 15 Nov. 1986 - 14 Nov. 1987
Dale A. Anderson 15 Dec. 1987 22 p
(Grant AF-AFOSR-0195-85)
(AD-A190953; AFOSR-88-0126TR) Avail: NTIS HC A03/MF A01 CSCL 12B

A summary of the technical work performed during the past twelve months under AFOSR Grant 85-0195 is presented in this report. Significant progress on a number of adaptive concepts was made. Problems associated with earlier adaptive mesh schemes controlling cell area/volume were resolved. Resolution of this difficulty led to the evolution of an adaptive orthogonal scheme for two-dimensional grids. This technique is even structurally simpler than the original Poisson equation based adaptive methods. Other research emphasis was placed on developing an unstructured solution scheme as a fast solver to generate these grids. GRA

N88-23529# Washington Univ., Seattle. Dept. of Statistics.
MIN-MAX BIAS ROBUST REGRESSION
R. D. Martin, V. J. Yohai, and R. H. Zamar Aug. 1987 40 p
(Contract N00014-84-C-0169)
(AD-A191345; TR-112) Avail: NTIS HC A03/MF A01 CSCL 12C

This paper considers the problem of minimizing the maximum asymptotic bias of regression estimates over epsilon-contamination neighborhoods for the joint distribution of the response and carriers. Two classes of estimates are treated: (1) M-estimates with bounded function rho applied to the scaled residuals, using a very general class of scale estimates, and (2) bounded influence function type generalized M-estimates. Estimates in the first class are obtained as the solution of a minimization problem, while estimates in the second class are specified by an estimating equation. The first class of M-estimates is sufficiently general to include both Huber Proposal 2 simultaneous estimates of regression coefficients and residuals scale, and Rousseeuw-Yohai S-estimates of regression. It is shown that an S-estimate based on a jump-function type rho solves the min-max bias problem for the class of M-estimates with very general scale. This estimate is obtained by the minimization of the alpha-quantile of the squared residuals, where alpha=(epsilon) depends on the fraction of contamination epsilon. When epsilon approaches limit of .5, alpha (epsilon) approaches limit of .5 and the min-max estimator approaches the least median of squared residuals estimator introduced by Rousseeuw. GRA

N88-23530*# Hampton Inst., Va. Dept. of Mathematics.
PERIODICALLY CORRELATED PROCESSES AND THEIR STATIONARY DILATIONS
A. G. Miamee [1988] 13 p
(Grant NAG1-768)
(NASA-CR-182904; NAS 1.26:182904) Avail: NTIS HC A03/MF A01 CSCL 12A

An explicit form for a stationary dilation for periodically correlated random processes is obtained. This is then used to give spectral conditions for a periodically correlated process to be non-deterministic, purely deterministic, minimal, and to have a positive angle between its past and future. Author

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

No abstracts in this category.

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-23531# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ON A GENERALIZATION OF RENORMALIZATION GROUP EQUATIONS TO QUANTUM FIELD THEORIES OF AN ARBITRARY TYPE
D. I. Kazakov 1987 6 p Submitted for publication
(DE88-701143; JINR-E-2-87-132) Avail: NTIS (US Sales Only) HC A02/MF A01

A generalization of renormalization group equations to the theories with arbitrary Lagrangians including nonrenormalizable ones is presented. In the framework of dimensional regularization these equations enable us to determine the coefficient functions of higher poles starting from a simple pole or generalized beta-functions, are presented. DOE

N88-23532# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
CLASSICAL NON-ABELIAN SOLUTIONS FOR NONSTANDARD LAGRANGIANS
A. I. Alekseev, A. S. Vshivtsev, and A. V. Tatarinov 1987 15 p In RUSSIAN; ENGLISH summary
(DE88-701305; IFVE-OTF-87-43) Avail: NTIS (US Sales Only) HC A03/MF A01

The solutions of field equations of motion are obtained for a definite class of effective Lagrangian is standard Wu-Yang anzatz for vector-potential. It is shown that real monopole and dyon type solutions can be obtained without introducing additional interaction with Higgs fields. The dyon configuration having a vanishing field density is found. The field equations of motion which can be expressed as a series in inverse powers of distance are investigated. The rearrangement of pure chromomagnetic field is shown to be energetically preferable to the configuration including a chromoelectric field component. Pure chromoelectric field configurations with distributed charge density are also investigated. DOE

N88-23533# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
MULTICONTINUATIONS METHOD AND STRONG REGULAR PERTURBATIONS OF LINEAR OPERATORS
N. V. Stepanov 1986 20 p In RUSSIAN; ENGLISH summary
(DE88-701375; ITEF-185(1986)) Avail: NTIS (US Sales Only) HC A03/MF A01

The method of multicontinuations is suggested to solve the problems of obtaining nonperturbative results using perturbation theory. The property of strong regularity (c-regularity) of perturbations is introduced. Some classical theorems are shown to be stable for relatively restricted perturbations and valid for the property of perturbation. An insignificant amount is substituted by the c-regularity property. Interrelation between c-regularity and holomorphy of operator and form families is considered. DOE

N88-23534# Los Alamos National Lab., N. Mex.
FINITE DIMENSIONALITY IN THE COMPLEX GINZBURG-LANDAU EQUATION
C. R. Doering, J. D. Gibbon, D. D. Holm, and B. Nicolaenko 1987 31 p Presented at the American Mathematical Society Meeting, Boulder, Colo., 1 Jun. 1987
(Contract W-7405-eng-36)
(DE88-006480; LA-UR-88-358; CONF-8706278-1) Avail: NTIS HC A03/MF A01

Finite dimensionality is shown to exist in the complex Ginzburg-Landau equation periodic on the interval (0,1). A cone condition is derived and explained which gives upper bounds on the number of Fourier modes required to span the universal attractor and hence upper bounds on the attractor dimension itself. In terms of the parameter R these bounds are not large. For instance, when vertical bar mu vertical bar less than or equal to the square root of 3, the Fourier spanning dimension is O(R(sup 3/2)). Lower bounds are estimated from the number of unstable side-bands using ideas from work on the Eckhaus instability. Upper bounds on the dimension of the attractor itself are obtained by bounding (or, for vertical bar mu vertical bar less than or equal to the square root of 3, computing exactly) the Lyapunov dimension and invoking a recent theorem of Constantin and Foias, which asserts that the Lyapunov dimension, defined by the Kaplan-Yorke formula, is an upper bound on the Hausdorff dimension. DOE

N88-23535# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Applied Mathematics.
PERTURBATION THEORY FOR DUAL SEMIGROUPS. PART 3: NONLINEAR LIPSCHITZ CONTINUOUS PERTURBATIONS IN THE SUN-REFLEXIVE CASE
Ph. Clement, O. Diekmann, M. Gyllenberg, H. J. A. M. Heijmans, and H. R. Thieme (Heidelberg Univ., West Germany) Sep. 1987 18 p

(CWI-AM-R8706-Pt-3; B8735760-Pt-3; ETN-88-92389) Copyright Avail: NTIS HC A03/MF A01

Nonlinear Lipschitz perturbations of the infinitesimal generator of a linear C sub 0-semigroup on a nonreflexive Banach space are considered. It is allowed that the perturbation maps the space into a bigger space which arises in a natural way when considering dual semigroups. Using a generalized variation-of-constants formula, it is shown that the perturbed operator generates a strongly continuous nonlinear semigroup. Regularity properties of this semigroup are studied, and the principle of linearized stability is proved. ESA

N88-23536# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
GRAPHS RELATED TO HELD'S SIMPLE GROUP
John v.Bon, Arjeh M. Cohen, and Hans Cuypers (Utrecht State Univ., Netherlands) Nov. 1987 18 p
(CWI-PM-28707; B8735758; ETN-88-92392) Copyright Avail: NTIS HC A03/MF A01

The permutation representations of low degree of Held's simple group He is analyzed. Its primitive multiplicity free permutation representations are determined. It is shown that there is no graph on which it or its automorphism group acts as a distance transitive group of automorphisms. A computer-free construction of He is given. ESA

N88-23537# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
EDGE-DISJOINT HOMOTOPIC PATHS IN STRAIGHT-LINE PLANAR GRAPHS
A. Schrijver Nov. 1987 19 p
(CWI-OS-R8718; B8737715; ETN-88-92415) Copyright Avail: NTIS HC A03/MF A01

Let G be a planar graph, embedded without crossings in the euclidean plane Rsq, and let l1, ..., lp be some of its faces (including the unbounded face), considered as open sets. Suppose there exist (straight) line segments L1, ..., Lt in Rsq so that Gul1u...ulp = L1u...uLtul1u...ulp and so that each Li has its end points in l1u...ulp. Let C1, ..., C1, be curves in Rsq/(l1u...ulp) with end points in vertices of G. Conditions under which there exist pairwise edge-disjoint paths P1, ..., Pk in G so that P1 is homotopic to Ci in Rsq/(l1u...ulp), for i = 1, ..., k are described. This extends results of Kaufmann and Mehlhorn (1986) for graphs derived from the rectangular grid. ESA

N88-23538# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Operations Research and System Theory.
DECOMPOSITION OF GRAPHS ON SURFACES AND A HOMOTOPIC CIRCULATION THEOREM
A. Schrijver Nov. 1987 52 p
(CWI-OS-R8719; B8737716; ETN-88-92416) Copyright Avail: NTIS HC A04/MF A01

Theorems on the decomposition into cycles of the edges of graphs embedded on a compact orientable surface are proved. A compact orientable surface is a two-dimensional sphere added with a finite number of handles. A characterization of the existence of a circulation of a prescribed homotopy type in such graphs is given. The proof methods used are based on analyzing curves on surfaces and their crossings, and on classical results in topology (due to Poincare, Baer, von Kerekjarto, Brouwer) and linear algebra (Farka's lemma). ESA

N88-23539# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
PAIRWISE COMPLETE REGULARITY AS A SEPARATION AXIOM
J. M. Aarts and M. Mrsevic (Belgrade Univ., Yugoslavia) 1987 18 p
(Rept-87-57; B8733838; ISSN-0920-8577; ETN-88-92434)
Copyright Avail: NTIS HC A03/MF A01

Characterizations of pairwise separation properties are presented in such a way that the characterization of pairwise complete regularity naturally fits in between those of pairwise regularity and pairwise normality. The unifying concept is that of a pair of bases or subbases for the closed sets of a bitopological space. It is noted that Steiner's separating family of closed sets is a basis for closed sets and, analogously, Seagrove's pairwise separating pair is a pair of closed bases for a bitopological space. This is exploited to exhibit the strong interrelation between the characterizations of complete regularity for the topological case and to extend this to the bitopological case using pairs of closed bases. Results are generalized to subbases. ESA

N88-23540# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
USING CLIFFORD ALGEBRAS FOR THE GEOMETRY OF A TUBE DOMAIN (AND ITS CORRESPONDING BOUNDED DOMAIN) IN THE COMPLEXIFIED MINKOWSKI SPACE OF ARBITRARY DIMENSION
Johannes G. Maks 1987 22 p
(Rept-87-64; B8733844; ISSN-0920-8577; ETN-88-92440)
Copyright Avail: NTIS HC A03/MF A01

The geometry of part of Minkowski spaces is considered from an algebraic point of view. The Minkowski spaces are realized in a Clifford algebra, containing the Twist representations of the Lorentz groups. ESA

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-23541# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
ALGORITHM FOR ACCOUNTING THE CONDITIONS IN INFINITY FOR TWO-DIMENSIONAL MAGNETOSTATICS PROBLEMS
Eh. A. Ajryan, E. P. Zhidkov, B. N. Khoromskij, and O. I. Yuldashev 1987 15 p In RUSSIAN; ENGLISH summary
(DE88-701673; JINR-R-11-87-49) Avail: NTIS (US Sales Only) HC A03/MF A01

An approach to solving magnetostatic two-dimensional problems in terms of one-component vector potential is developed. On the boundary of the ferromagnetic region the boundary integral equations (BIE) are used as a boundary condition. For the linear case and smooth coefficients of the differential equation the positiveness of differential opereator is proved. Two different approximations of the problem are considered. A unique solvability of the difference equation is proved. For the second difference approximation the positiveness of the difference operator is established. The algorithm proposed is especially efficient when solving of the differential equation (linear or nonlinear) in a limited region is a more difficult problem than solving BIE. Some numerical results are given. DOE

N88-23542*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOCAL TIME DISPLACEMENT AS A SYMMETRY OF NATURE IN FLAT SPACE-TIME
Willard E. Meador and Lawrence W. Townsend Apr. 1988 16 p
(NASA-TM-100610; NAS 1.15:100610) Avail: NTIS HC A03/MF A01 CSCL 20C

Local time displacement is shown to be a true symmetry of Minkowskian physics, thereby demonstrating the empirical equivalence of different choices of the clock synchronization parameter in generalized Lorentz transformations. Author

N88-23543# Naval Research Lab., Washington, D.C.
NAVAL RESEARCH REVIEWS, VOLUME 39, NUMBER 3

W. J. Lescure 1987 33 p
(AD-A191392) Avail: NTIS HC A03/MF A01 CSCL 05A

This report on naval research contains the following: Future of Brain and Information Research; Winter MIZEX (Marginal Ice Zone Experiment) 87: Operations Overview; Atmospheric Research at the Naval Environmental Prediction Research Facility; Profiles in Science; and Research Notes. GRA

N88-23544# Oxford Univ. (England).
NONLINEAR WAVE AND DIFFUSION EQUATIONS
J. B. McLeod Oct. 1987 10 p
(Contract DAJA45-86-C-0040)
(AD-A191421) Avail: NTIS HC A02/MF A01 CSCL 20L

Work done during the relevant period fell under the following headings: (1) Lens and Antenna Design. The problem here is, given two points, to design an optical lens which will have the property that it focusses all rays of light from the one point onto the other; (2) Nonlinear Diffusion and Free Boundary Problems. During this period, much of the work in nonlinear diffusion centered on the fabrication of semiconductors. In particular, Dr. J. R. King completed his thesis on the mathematical aspects of semiconductor process modelling, and he and C. P. Please wrote a paper on diffusion in crystalline silicon. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-23545*# Cambridge Acoustical Associates, Inc., Mass.
STRUCTUREBORNE NOISE MEASUREMENTS ON A SMALL TWIN-ENGINE AIRCRAFT
J. E. Cole, III and K. F. Martini Washington NASA Jun. 1988 71 p
(Contract NAS1-18020)
(NASA-CR-4137; NAS 1.26:4137; U-1541-349-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 20A

Structureborne noise measurements performed on a twin-engine aircraft (Beechcraft Baron) are reported. There are two overall objectives of the test program. The first is to obtain data to support the development of analytical models of the wing and fuselage, while the second is to evaluate effects of structural parameters on cabin noise. Measurements performed include structural and acoustic responses to impact excitation, structural and acoustic loss factors, and modal parameters of the wing. Path alterations include added mass to simulate fuel, variations in torque of bolts joining wing and fuselage, and increased acoustic absorption. Conclusions drawn regarding these measurements are presented. Author

N88-23546# National Aerospace Lab., Amsterdam (Netherlands). Structures Dept.
AERODYNAMIC NOISE OF WIND TURBINES
W. B. deWolf 12 Jan. 1987 25 p In DUTCH; ENGLISH summary Presented at the Noise and Wind Turbines Workshop, Utrecht, Netherlands, 19 Feb. 1987
(PB88-165188; NLR-MP-87004-U; B8729625; ETN-88-91734)
Avail: NTIS HC A03/MF A01 CSCL 20A

Research on aerodynamic noise generation in wind turbines with horizontal axis and upwind rotor configuration is reviewed. A simple formula for a first estimate of the noise level is presented. A more detailed computation model is discussed with results and recommendations for further study. ESA

N88-23547*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ADVANCED TURBOPROP AIRCRAFT FLYOVER NOISE: ANNOYANCE TO COUNTER-ROTATING-PROPELLER CONFIGURATIONS WITH AN EQUAL NUMBER OF BLADES ON EACH ROTOR, PRELIMINARY RESULTS
David A. McCurdy May 1988 35 p Presented at the 115th Acoustical Society of America Conference, Seattle, Wash., 16-20 May 1988
(NASA-TM-100612; NAS 1.15:100612) Avail: NTIS HC A03/MF A01 CSCL 20A

A laboratory experiment was conducted to quantify the annoyance of people to the flyover noise of advanced turboprop aircraft with counter-rotating propellers (CRP) having an equal number of blades on each rotor. The objectives were: to determine the effects of total content on annoyance; and compare annoyance to n x n CRP advanced turboprop aircraft with annoyance to conventional turboprop and jet aircraft. A computer synthesis system was used to generate 27 realistic, time-varying simulations of advanced turboprop takeoff noise in which the tonal content was systematically varied to represent the factorial combinations of nine fundamental frequencies and three tone-to-broadband noise ratios. These advanced turboprop simulations along with recordings of five conventional turboprop takeoffs and five conventional jet takeoffs were presented at three D-weighted sound pressure levels to 64 subjects in an anechoic chamber. Analyses of the subjects' annoyance judgments compare the three aircraft types and examined the effects of the differences in tonal content among the advanced turboprop noises. The annoyance prediction ability of various noise metrics is also examined. Author

N88-23548*# Sikorsky Aircraft, Stratford, Conn.
ACOUSTIC CHARACTERISTICS OF 1/20-SCALE MODEL HELICOPTER ROTORS
Rajarama K. Shenoy, Fred W. Kohlhepp, and Kenneth P. Leighton Aug. 1986 144 p
(Contract NAS2-11310)
(NASA-CR-177355; NAS 1.26:177355; SER-510248) Avail: NTIS HC A07/MF A01 CSCL 20A

A wind tunnel test to study the effects of geometric scale on acoustics and to investigate the applicability of very small scale models for the study of acoustic characteristics of helicopter rotors was conducted in the United Technologies Research Center Acoustic Research Tunnel. The results show that the Reynolds number effects significantly alter the Blade-Vortex-Interaction (BVI) Noise characteristics by enhancing the lower frequency content and suppressing the higher frequency content. In the time domain this is observed as an inverted thickness noise impulse rather than the typical positive-negative impulse of BVI noise. At higher advance ratio conditions, in the absence of BVI, the 1/20 scale model acoustic trends with Mach number follow those of larger scale models. However, the 1/20 scale model acoustic trends appear to indicate stall at higher thrust and advance ratio conditions. Author

N88-23549# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
OVERGROUND EXCESS SOUND ATTENUATION (ESA). VOLUME 1: EXPERIMENTAL STUDY FOR FLAT GRASSY TERRAINS Final Report, Jul. 1979 - Jun. 1987
Robert G. Powell Jun. 1987 702 p
(AD-A191289; AAMRL-TR-84-017-Vol-1) Avail: NTIS HC A99/MF E03 CSCL 20A

This is Volume 1 of a 3 volume series concerning overground excess sound attenuation, ESA, i.e., all attenuation in excess of air absorption and inverse square law effects. All three volumes concern a 15-month study conducted at Wright-Patterson Air Force Base, Ohio, over flat, grassy terrain. Volume 1 describes the study and presents the acoustic and meteorological data base that Volumes 2 and 3 use to formulate ESA functions. The study is described in terms of propagation path, instrumentation, reference noise levels, data acquisition techniques, calibration procedures, the noise source and its location. A large portion of this report is devoted to two appendices. Appendix A contains one-third octave band sound pressure levels, overall and A-weighted levels for 415 events. The noise data come from 10 microphones spaced along a 2400 M propagation path. Appendix B lists one-third octave band, overall and A-weighted ESA values in dB. Also included in this appendix are measures of temperature, relative humidity, wind velocity, wind vector relative to source-receiver position,

temperature and wind gradients, and meteorological observations. The data in this volume was used to develop a new USAF ESA model which is presented in Volume 3. GRA

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-23550# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.

STARK EFFECT IN INTENSE FIELD. PERTURBATION THEORY AND 1/n-EXPANSION

V. S. Popov, V. D. Mur, V. M. Veinberg, and A. V. Shcheblykin 1986 29 p In RUSSIAN; ENGLISH summary

(DE87-702947; ITEP-125(1986)) Avail: NTIS (US Sales Only) HC A03/MF A01

The problem of the Stark effect in a hydrogen atom is considered. The computation results of higher orders of perturbation series (PS) are briefly described. Stark shifts and widths of the ground and excited states of the hydrogen atom in the intense electric field epsilon are computed by two independent methods: PS summation and 1/n expansion. The first method works well at n -- 1, while the second fastly converges in the case of Rydberg states, n >> 1. DOE

N88-23551 Max-Planck-Inst. fuer Quantenoptik, Garching (West Germany).

ELECTRONIC STRUCTURE OF MATTER AT HIGH COMPRESSION: ISOSTRUCTURAL TRANSITIONS AND APPROACH OF THE FERMI-GAS LIMIT

J. Meyer-ter-Vehn and W. Zittel Jul. 1987 72 p Submitted for publication

(MPQ-124; ETN-88-91945) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The effect of atomic shell structure on the cold pressure of highly compressed matter up to 1 Gbar and above was assessed. Band structure calculations based on augmented spherical waves were compared with results of the quantum-statistical model. Elements treated are Li, He, Be, Al, and K. No indication for anomalies due to pressure ionization is found. However, oscillatory behavior of cold pressure curves is systematically obtained due to isostructural electronic transitions. They are traced back to pressure-induced band shifts and electron redistribution from bands of low angular momentum (typically s and p-waves) to bands of higher angular momentum (typically d and f-waves). The shifts are shown to occur generally when squeezing normal matter with extended atoms into highly degenerated matter. The anomalies are particularly pronounced for alkali metals: strong pressure flattening is found for Li at 5-fold compression and 5 to 10 Mbar, and very sharply for K below 5-fold compression and 500 kbar. The oscillations are much weaker for Be and Al. Metallization of He is obtained at 12.1 g/cc and 110 Mbar. For Be, a structural hcp yields bcc transition at 2 Mbar is predicted. ESA

N88-23552# Utrecht State Univ. (Netherlands).

AN ELECTRON-SCATTERING STUDY OF N-15 Ph.D. Thesis

Johannes Weitze deVries 1987 78 p Sponsored by the Foundation for Fundamental Research on Matter, The Netherlands and the Netherlands Organization for the Advancement of Pure Research

(ETN-88-92479) Avail: NTIS HC A05/MF A01

An electron scattering experiment was carried out on N-15 to test results of shell model calculations using two approaches to calculate nucleon interactions: a phenomenological interaction valid throughout the 1p-shell, and adjustment of interaction parameters to fit the excitation energies of a number of states in a particular nucleus. Form factor and charge density of the ground state are adequately described by both approaches. For the description of the experimental results for many of the observed levels considerable effective charges are needed to reproduce the transition strength. This indicates that contributions of excitations outside the shell-model space used are also important, especially for highly excited states. It is concluded that the calculation of electromagnetic properties in a full (0+2)h omega model space opens a wide range of possibilities, compared to the 0h omega approach, that can only described the lowest two negative parity states of N-15. ESA

N88-23553# Colorado Univ., Boulder.

TIME-RESOLVED STUDIES OF FREE RADICALS AND LASER-INITIATED CHAIN REACTIONS Final Report, 1 Apr. 1979 - 31 Mar. 1988

Stephen R. Leone Mar. 1988 6 p

(Contract DE-AC02-79ER-10396)

(DE88-006569; DOE/ER-10396/8) Avail: NTIS HC A02/MF A01

Pulsed lasers were used in this work to photofragment molecules or to initiate chain reactions. One of the major advances was the availability of high-powered rare gas halide excimer lasers. In addition, pulsed Nd:YAG lasers and dye lasers were used throughout. Results include: generalized kinetic formulations of the problem of laser-initiated chain reactions. Several studies were carried out to explore the details of chain combustion phenomena, slow chain reactions, chain branching behavior, and vibrational temperatures of combusting mixtures. A method to determine the rotational temperature of nitrogen molecules by laser multiphoton ionization was shown. The chain reaction methodology was applied to complex polyatomic systems, in which complete infrared spectra of the emitting species were obtained. Systems studied included chlorine + HBr, HI, methane, hydrogen, ethane, propane, butane, cyclopropane, and cyclohexane. Photofragmentation studies involved the production and analysis of radical species, such as methyl, CH_2I, and CCH. Molecules studied included methylene iodide, methyl iodide, dimethyl mercury, acetone, acetylene, vinyl chloride, dichloroethylene, and fluorochloroethylene. The first infrared characterization of a highly vibrationally excited radical was shown. Reactions of methyl radicals were studied in detail, in which a new method for obtaining absolute values of the methyl radical reaction rates were obtained. DOE

N88-23554# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.

PPDS COMPAS-PRIMER

S. I. Alekhin, V. V. Bazeeva, and S. N. Grudtsin et al. 1987 40 p In RUSSIAN; ENGLISH summary

(DE88-701589; IFVE-OEIUNK-87-125) Avail: NTIS (US Sales Only) HC A03/MF A01

A catalogue of IHEP data bases on particle physics (PPDS) and a short guide for the unexperienced user are presented. All data bases are under a common data base management system and include bibliographic and factographic ones. Binary search and set of applied programs controlling input and formatting output make using the system easy and convenient. Basic programs are developed in FORTRAN. DOE

N88-23555# Dayton Univ., Ohio.

PROCEEDINGS OF THE COOLING, CONDENSATION, AND STORAGE OF HYDROGEN CLUSTER IONS WORKSHOP

John T. Bahns Dec. 1987 298 p Workshop held in Menlo Park, Calif., 8-9 Jan. 1987

(AF Proj. 2301)

(AD-A189857; AFAL-CP-87-003) Avail: NTIS HC A13/MF A01 CSCL 07B

This workshop was held from 8 to 9 January 1987 at SRI International, Menlo Park, Calif. This workshop was conducted in order to explore the critical issues involving the containerless condensation of hydrogen cluster ions. The areas covered include cluster ions, ion traps, and laser cooling. For individual titles, see N88-23556 through N88-23577.

N88-23556# Hughes Research Labs., Malibu, Calif.
PROSPECTS FOR ANTIPROTON PRODUCTION AND PROPULSION **c20**
Robert L. Forward *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 11-26 (For primary document see N88-23555 16-72)
(Contracts F04611-86-C-0039; F04611-83-C-0013; F04611-83-C-0046)
Avail: NTIS HC A13/MF A01 CSCL 21F

Antiproton annihilation propulsion is a new form of space propulsion, where milligrams of antiprotons in the form of frozen crystals of antihydrogen are used to heat tons of reaction fluid to high temperatures. The hot reaction fluid is exhausted from a nozzle to produce high thrust at high exhaust velocity. The results are summarized of a continuing study of antiproton annihilation propulsion. A conclusion reached is that antipropulsion is possible but expensive. Some ideas are outlined for improving the generation efficiency of antiprotons and techniques are described for the cooling, trapping, long term storage, and effective utilization of milligram quantities of antihydrogen for space propulsion. Author

N88-23557# SRI International Corp., Menlo Park, Calif. Chemical Physics Lab.
OVERVIEW OF HYDROGEN CLUSTERS
Roberta P. Saxon *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 29-37 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 21F

Equilibrium geometries and energetics of the ground states of hydrogen cluster ions obtained from theoretical calculations are reviewed. Possible roles of excited states in promoting association reactions to form H+ sub n by H atom addition are considered and available information for H+ sub 3 electronic states is surveyed. Author

N88-23558# Iowa Univ., Iowa City. Laser Facility.
LARGE HYDROGEN CLUSTER IONS
William C. Stwalley *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 41-46 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The concept of growth/fragmentation cycles for large hydrogen cluster ion in an ion trap is summarized. The various possible collisional processes are listed and briefly discussed with emphasis on the positive ion growth and fragmentation processes. Author

N88-23559# Maryland Univ., College Park. Dept. of Chemistry.
ASSOCIATIVE TWO-BODY CONDENSATION IN LASER-COOLED SODIUM AND HYDROGEN
John Weiner *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 49-59 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The concept is summarized of two body associative ionization and radiative association in sodium atom collisions and hydrogen atom collisions. The feasibility is examined of using these processes to promote condensation into polyatomic clusters without recourse to collisional relaxation. Author

N88-23560# California Univ., Santa Barbara. Dept. of Chemistry.
FORMATION AND REACTIVITY OF SMALL HYDROGEN CLUSTER IONS
Michael T. Bowers *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 63-72 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

A specially designed coaxial drift tube type ion source was utilized to generate ionic hydrogen clusters. The cluster mass spectrum is dominated by odd clusters in line with past studies on hydrogen ion clusters. For the first time, even cluster ions are formed with relative intensities. The observation of a relatively intense H6(+) peak was unexpected. The peak at nominal mass 6 was confirmed to be H6(+) and not H4D(+) by high resolution analysis. A number of possible formation mechanisms are proposed. The most likely is reaction of H3(+) or H5(+) with metastable electronically excited H3(+) or H5(+). Author

N88-23561# California Univ., Berkeley. Dept. of Chemistry.
THE H5(+) POTENTIAL ENERGY HYPERSURFACE: CHARACTERIZATION OF TEN DISTINCT ENERGETICALLY LOW-LYING STATIONARY POINTS
Yukio Yamaguchi, Jeffrey F. Gaw, Richard B. Remington, and Henry F. Schaefer, III *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 75-79 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

Ab initio molecular electronic structure theory was used in an attempt to characterize the low lying stationary points on the H5(+) potential energy hypersurface. Three distinct levels of theory were used: the self consistent field method, configuration interaction including all single and double excitations, and full configuration interaction. Four different basis sets were used: double zeta, double zeta plus polarization, and extended basis set designated H (6s2p/4s2p) and a second extended basis designated H (8s3p/6s3p). The higher levels of theory are in agreement that only minimum for H5(+) is a C sub 2v structure, with three other stationary points (of D sub 2d, C sub 2v, and D sub 2h symmetries) lying less than one kcal/mole higher in energy. The predicted dissociation energy D sub o is 5.5 kcal/mole, which is estimated to be about one kcal/mole less than the exact D sub o. Author

N88-23562# United Technologies Research Center, East Hartford, Conn.
ELECTRONIC STRUCTURE AND STABILITY OF SMALL CATION AND ANION HYDROGEN CLUSTERS
J. A. Montgomery, Jr. and H. H. Michels *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 83-94 (For primary document see N88-23555 16-72)
(Contracts F49620-85-C-0095; F04611-86-C-0071)
Avail: NTIS HC A13/MF A01 CSCL 07B

Ab initio calculations of the electronic structure of H sub n (-) and H sub n (+) clusters were carried out using accurate Gaussian basis sets and with levels of theory up to fourth order perturbation theory and single and double excitation configuration interaction. The odd hydrogen cation addition sequence, H sub n (+) + H2 + H sub n+2(+), appears to be thermodynamically stable for large size cluster formation. The even H6(+) cation also exhibits surprising stability in D sub 2d symmetry. In contrast, the hydrogen anion addition sequence, H sub n(-) + H + H sub n+1(-) and H sub n(-) + H2 + H sub n+2(-), appear to be thermoneutral or unstable. Author

N88-23563# SRI International Corp., Menlo Park, Calif. Molecular Physics Dept.
PHOTON-ASSISTED FORMATION AND COOLING OF MOLECULAR HYDROGEN
Hanspeter Helm *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 97-109 (For primary document see N88-23555 16-72)
(Contract F08671-C-87-00432)
(MP-87-102) Avail: NTIS HC A13/MF A01 CSCL 07B

Photon assisted reactions are discussed for forming molecular hydrogen ions from protons and hydrogen atoms using free bound absorption of the collision complex. The possibility is discussed also of forming very weakly bound, electronically excited H2(+) molecules in collisions between two electrons and two protons. A

third topic explores stimulated Raman scattering as a technique to cool internal excitation of the molecules. Author

N88-23564# California Univ., Berkeley. Dept. of Chemistry.
QUANTUM MONTE CARLO STUDY OF THE MIES ASSOCIATED WITH H2(X 1 SIGMA g +) AND H2(B 1 SIGMA u +)
Sheng-Yu Huang and William A. Lester, Jr. *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 111-118 Prepared in cooperation with California Univ., Berkeley, Lawrence Berkeley Lab. (For primary document see N88-23555 16-72)
(Contracts F04611-85-X-0068; DE-AC03-76SF-00098)
Avail: NTIS HC A13/MF A01 CSCL 07B

Excited states of interacting systems, that are bound in the ground state only by van der Waals forces, can interact to form strongly bound species. This is found for systems in which only one of the fragments is excited, and is exemplified by the excimer states He-He*, Ar-Ar*, and H2-H2*. Here the asterisk denotes the first excited state of the same spin symmetry as the ground state. A model based on maximum ionicity excited states (MIES) properties suggests that bound excited states of polyatomic systems can be formed in regions characterized by an avoided crossing with the ground state, if one of the interacting molecules can exist in a MIES. Studies of the H2*-H2 system are in progress using the fixed node quantum Monte Carlo (FNQMC) method. A brief introduction to this method is given. Author

N88-23565# Lawrence Livermore National Lab., Calif.
INFRARED SPECTROSCOPY OF H3(+) **c25**
Mark Crofton *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 121-124 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07D

The methods and results of infrared spectroscopy of H3(+) by Oka and others are outlined. Possible application of similar methods to the spectroscopy of hydrogenic species such as H5(+) is discussed. Author

N88-23566# California Univ., Berkeley. Lawrence Berkeley Lab. Materials and Chemical Science Div.
VIBRATIONAL SPECTROSCOPY OF THE HYDROGEN AND HYDRATED HYDRONIUM CLUSTER IONS **c25**
L. I. Yeh, M. Okumura, J. D. Myers, and Y. T. Lee *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 127-141 (For primary document see N88-23555 16-72)
(Contract DE-AC03-76SF-00098; Grant NSF CHE-79-16250)
Avail: NTIS HC A13/MF A01 CSCL 07D

Two series of cluster ions were investigated. The hydrogen cluster ions H sub n(+) (n=5,7,9,11,13,15) were probed in the region of the H-H stretch frequency from 3800 to 4200/cm. These hydrogen cluster ions consist of an H3(+) core which is solvated by H2 moieties. Upon excitation of an H-H stretch, these ions undergo vibrational predissociation losing one or more H2 units. Absorption is monitored by detecting the fragment ions as a function of the probe frequency. Broad absorption bands were seen for these hydrogen cluster ions. The peak absorption position increased significantly with larger cluster size to H9(+) and then remained essentially constant to H15(+). The hydrated hydronium ions were studied in a similar fashion. A probe laser was tuned from 3550 to 3800/cm to excite an O-H stretch. The dissociation energy was much larger than the probe laser frequency. Therefore, a second laser was employed which utilized the multiphoton dissociation process. Again, fragment ions were monitored as a function of the probe frequency. In this series the antisymmetric and symmetric O-H stretch of the H2O moieties was observed. Author

N88-23567# University of Western Ontario, London. Dept. of Physics.
THE ROLE OF ELECTRON-ION RECOMBINATION IN BULK ANTIMATTER PRODUCTION
J. B. A. Mitchell *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 145-156 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The difference between the recombination of electrons with atomic ions and molecular ions is outlined. Methods for studying recombination processes experimentally are described. A discussion is given of how electron ion recombination must be optimized in order to maximize the production of antimatter cluster ions. Author

N88-23568# National Bureau of Standards, Gaithersburg, Md. Electricity Div.
ELECTROMAGNETIC MANIPULATION OF ATOMIC HYDROGEN
William D. Phillips, Phillip L. Gould, and Paul D. Lett *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 159-164 Sponsored in part by ONR, Washington, D.C. (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The production of atomic antihydrogen and its condensation into molecules and clusters is likely to involve various techniques of laser cooling, electromagnetic trapping, and other kinds of electromagnetic manipulations. Some of the possibilities are reviewed for electromagnetic manipulation as they apply to atomic hydrogen. Author

N88-23569# Washington Univ., Seattle. Dept. of Physics.
FIRST CAPTURE OF ANTIPROTONS IN AN ION TRAP AND THE POSSIBILITY OF ANTIHYDROGEN
G. Gabrielse *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 167-173 Presented at the International School of Physics with Low Energy Antiprotons: Fundamental Symmetries, Erice, Italy, 24 Sep. - 4 Oct. 1986 Submitted for publication Sponsored in part by NSF, Washington, D.C., NBS, Washington, D.C. and AFOSR, Washington, D.C. (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The motivation and prospects for a measurement of the inertial mass of the antiproton are discussed. Prospects for such a measurement are excellent since the TRAP Collaboration actually captured antiprotons in a Penning trap. An overview of ways to cool particles within the trap is provided and brief speculations upon the possibility of producing antihydrogen in a trap are included. Author

N88-23570# National Bureau of Standards, Boulder, Colo. Time and Frequency Div.
ION TRAPS FOR LARGE STORAGE CAPACITY
D. J. Wineland *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 181-194 Sponsored in part by ONR, Washington, D.C. and AFOSR, Washington, D.C. (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

Ion storage in Penning-type or RF (Paul)-type traps is discussed. Emphasis is given to low energy, long term confinement of high densities and large numbers of ions. Maximum densities and numbers are estimated using a low temperature, static model of the ion plasmas in the traps. Destabilizing mechanisms are briefly discussed. Author

N88-23571# Maryland Univ., College Park.
LONG DURATION COHERENT LYMAN-ALPHA SOURCES
Thomas J. McIlrath *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop

Dec. 1987 p 197-203 Prepared in cooperation with NBS, Gaithersburg, Md. (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

Resonant radiation at 1215.56 A for cooling and trapping of atomic hydrogen can be produced by parametric upconversion of visible laser outputs. Several gases and vapors were shown to be suitable for generating 1215 A radiation with verified conversion efficiencies of greater than 0.0001. A scenario for producing long pulse outputs similar to or greater than 10 W power using proven techniques is discussed. Author

N88-23572# Cornell Univ., Ithaca, N.Y. Dept. of Applied Physics.
MAGNETIC TRAPS FOR AN ANTI-HYDROGEN GAS
Richard Lovelace, Dave Thompson, and Dave Lee *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 207-217 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

Magnetic traps are described for the confinement of a dense, collisional gas of spin polarized antihydrogen. Three dimensional dynamic magnetic traps are discussed where the magnetic field includes a fast time dependent component. The dynamic trap must provide containment in the presence of frequent collisions. The collisionless confinement of a single atom is analyzed. Then, the influence of collisions using the Boltzmann transport equation and a Monte Carlo code for the numerical evaluation of particle orbits including collisions is investigated. Finally, a storage ring for neutral atoms is described. Author

N88-23573# Air Force Astronautics Lab., Edwards AFB, Calif.
KEY PROBLEMS AND HYDROGEN ATOM FORMATION
J. T. Bahns *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 221-230 (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

First, key problem areas in the cluster ion approach to containerless condensation are reviewed. Then, problems and strategies involving the first step in the overall synthesis (H atom formation) are discussed. Author

N88-23574# Hughes Research Labs., Malibu, Calif.
PRODUCTION OF HEAVY ANTINUCLEI: REVIEW OF EXPERIMENTAL RESULTS
Robert L. Forward *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 p 233-244 (For primary document see N88-23555 16-72)
(Contract F04611-86-C-0039)
Avail: NTIS HC A13/MF A01 CSCL 07B

Antinuclei heavier than antiprotons, such as antideuterons, antitritons, antihelium-3, and larger antinuclei, might be useful in the initial phases of the nucleation and growth of antihydrogen cluster ions from antiprotons and antielectrons (positrons). The experimental work is summarized which has been performed to date on the production of antideuterium, antitritium, and antihelium nuclei, and the prospects for production of heavier antinuclei such as antilithium. In addition, there are alternative proposals for producing antideuterium through colliding beams of antiprotons that may ultimately prove to be more effective in producing significant quantities of captured antideuterons. Extension of these techniques to colliding beams of heavy antinuclei may even allow fabrication of small amounts of very heavy antinuclei that are not feasible using the straight proton target production approach. Author

N88-23575# Air Force Astronautics Lab., Edwards AFB, Calif.
THE CLUSTER ION APPROACH TO THE CONDENSATION AND STORAGE OF ANTIHYDROGEN
J. T. Bahns *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 30 p (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The problem of concentrating antiprotons and positrons into a high energy density form is analyzed from the viewpoint of the containerless condensation of hydrogen cluster ions in traps using ion-neutral association. The constraints that lead to the proposed method and the available ion-neutral association channels are discussed. It is found that the condensation method should (if possible) avoid the use of neutral hydrogen dimers. It is concluded that the condensation to produce the first seed (critically sized) cluster ions need only to be done once to surmount the main problems associated with containerless condensation. Author

N88-23576# Iowa Univ., Iowa City.
ANALYSIS OF CONTAINERLESS CONDENSATION OF POLYATOMIC HYDROGEN IONS, WITH EMPHASIS ON H3(+,-) ASSOCIATION CHANNELS AND A FUTURE WORKSHOP TO STUDY RELATED TOPICS
William C. Stwalley *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 8 p (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

Antimatter propulsion has been identified as a possible technology for a wide variety of propulsion applications. For an antiproton propulsion system, antiprotons must be produced, slowed to low energy and condensed to a high density form suitable for propulsion, while maintaining containerless (collisionless) conditions; i.e., there must be no contact with walls of ordinary matter to avoid catastrophic matter-antimatter annihilation. Means of achieving this technology is studied. Author

N88-23577# Iowa Univ., Iowa City.
SMALL MOLECULE AND SMALL CLUSTER ION FORMATION IN A LOW-DENSITY CONTAINERLESS MIXTURE OF ELECTRONS, PROTONS AND HYDROGEN ATOMS
K. M. Sando *In* Dayton Univ., Proceedings of the Cooling, Condensation and Storage of Hydrogen Cluster Ions Workshop Dec. 1987 12 p (For primary document see N88-23555 16-72)
Avail: NTIS HC A13/MF A01 CSCL 07B

The possibility and means of producing condensed antimatter is investigated. There is, however, no chemical difference between antimatter and matter and initial experiments were done with matter for reasons of cost and availability. The formation of large cluster ions was shown to be a promising method of producing bulk antimatter in a containerless environment. The production of cold antielectrons, protons and hydrogen atoms is believed to be feasible. This dicussion is limited to the production of small to medium sized cluster ion from electrons, protons, and hydrogen atoms. Cold hydrogen molecules may be more effective for increasing the size of a cluster ion than hydrogen atoms. Because there is no known method for producing cold hydrogen molecules in a low density, containerless environment, some discussion of hydrogen molecule formation is also given. Author

N88-23578# Johns Hopkins Univ., Baltimore, Md.
ENERGY TRANSFER PROCESSES IN FREE RADICALS: A COLLABORATIVE EXPERIMENTAL AND THEORETICAL INVESTIGATION Final Report, 19 Dec. 1984 - 18 Dec. 1987
Millard H. Alexander and Paul J. Dagdigian 20 Jan. 1988 15 p
(Contract DAAG29-85-K-0018)
(AD-A191264; ARO-22349.17-CH) Avail: NTIS HC A03/MF A01 CSCL 07D

Rotationally and electronically inelastic collisions in small molecules and free radicals have been studied with both initial and final state resolution in a joint theoretical-experimental project. Particular emphasis has been placed on diatomic free radicals of importance in combustion environments. State-to-state cross sections for transitions within the A2pi and to the X2sigma+ state of the CN radical in collisions with argon have been measured in a discharge-flow technique. Experimental investigation on the mechanism for the dependence of chemical reactivity on the fine-structure level of a reactant atomic multiplet has also been carried out. GRA

N88-23579# Louisiana State Univ., Baton Rouge.
CLUSTERS OF TRANSITION METAL ATOMS Final Report, 20 Dec. 1984 - 31 Jan. 1988
J. Gallaway Jan. 1988 13 p
(Contract DAAG29-85-K-0036)
(AD-A191265; ARO-22445.16-PH) Avail: NTIS HC A03/MF A01 CSCL 07B

The primary objective of developing improved techniques for calculating the electronic structure of clusters on the basis of density functional theory was accomplished. The methods are the most accurate presently available. The most important topic which is not yet treated satisfactorily in our approach or in any of the competing methods is that of embedding the cluster, i.e., treating its environment properly. New results were obtained for several interesting systems. GRA

N88-23580# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
THEORETICAL CALCULATIONS OF XeF GROUND STATE KINETICS
Roger L. Wilkins 1 Mar. 1988 42 p
(Contract F04701-85-C-0086)
(AD-A191398; TR-0086A(2061)-1; SD-TR-8839) Avail: NTIS HC A03/MF A01 CSCL 07B

State-to-state rate coefficients were calculated for collision-induced vibrational-to-translational (V-T) and rotational-to-translational (R-T) relaxation, and for dissociation processes that occur when XeF(v,J) molecules collide with He atoms. Three-dimensional classical trajectories of the collision dynamics of these processes were calculated by means of a pairwise additive potential energy surface, which consists of a Morse function for the XeF interaction and Lennard-Jones functions for the HeXe and HeF interactions. On the basis of trajectory calculations, it is predicted that V-T relaxation and R-T relaxation occur by multiquanta transitions, and that dissociation occurs from all the v-levels by the formation of XeF molecules in unstable rotational levels above the centrifugal barrier. As the XeF(v) molecules are carried to higher v-levels by the V-T relaxation processes, they are more easily dissociated. Both the temperature and v-dependences of the state-to-state rate coefficients were calculated for V-T and R-T relaxation and collision-induced dissociation. GRA

N88-23581# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
IMPLICATIONS OF THE TRAPPING-DESORPTION AND DIRECT INELASTIC SCATTERING CHANNELS ON DICKE-NARROWED LINESHAPES
R. P. Frueholz and J. C. Camparo 12 Feb. 1988 28 p
(AD-A191410; TR-0086(6945-05)-7; SD-TR-88-31) Avail: NTIS HC A03/MF A01 CSCL 20E

The Dicke-narrowed lineshape of an atom in a wall-coated, bufferless, atomic storage cell is composed of two parts, a sharp central spike and a broad underlying pedestal. To understand the pedestal shape, we find that it is necessary to account for various atom-surface scattering channels. Conversely, analysis of the pedestal shape yields information concerning these scattering channels. In particular, nearly Doppler-broadened pedestals, observed for alkali hyperfine transitions in cells with paraffin coatings, indicate that both a trapping-desorption channel and a direct inelastic/quasi-elastic channel are accessible in the atom-surface scattering process. Alternatively, the appearance of much narrower pedestals, observed in cells with dichlordimethylsilane coatings, indicates that the trapping desorption channel dominated the atom-surface scattering process. GRA

N88-23582*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
X-RAY PRODUCTION IN LOW ENERGY PROTON STOPPING
J. W. Wilson, G. S. Khandelwal, and N. T. Fogarty (Hampton Inst., Va.) Apr. 1988 12 p
(NASA-TM-100619; NAS 1.15:100619) Avail: NTIS HC A03/MF A01 CSCL 20H

The X-ray yields of stopping protons in an iron-nickel-cobalt alloy are calculated for use in predicting radiation damage in encased electronic devices. Author

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-23583# Brookhaven National Lab., Upton, N. Y.
REFERENCE NUCLEAR DATA FOR SPACE APPLICATIONS
S. Pearlstein 1987 8 p Presented at the Conference on High Energy Radiation Background in Space, Sanibel Island, Fla., 3 Nov. 1987
(Contract DE-AC02-76CH-00016)
(DE88-007041; BNL-NCS-40821; CONF-8711149-2) Avail: NTIS HC A02/MF A01

The National Nuclear Data Center (NNDC) at Brookhaven National Laboratory is active in the development of high energy data bases for space applications. Validated data and methods of interaction analysis are needed to explain and predict radiation patterns. The NNDC uses methods consisting of nuclear systematics and nuclear model codes to provide neutron and proton induced reaction data from 1 MeV and 1 GeV. The data can be placed in convenient form for use by radiation transport codes. In addition to cross-sections, nuclear structure and radioactive decay data are also stored in data bases. Data are distributed by the NNDC in a variety of ways including on-line access through computer networks or telephone lines. DOE

N88-23584*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMPUTER PROGRAM FOR PARAMETERIZATION OF NUCLEUS-NUCLEUS ELECTROMAGNETIC DISSOCIATION CROSS SECTIONS
John W. Norbury, Lawrence W. Townsend, and Forooz F. Badavi (Planning Research Corp., Hampton, Va.) Jun. 1988 28 p
(Contract NCC1-110)
(NASA-TM-4038; L-16427; NAS 1.15:4038) Avail: NTIS HC A03/MF A01 CSCL 20H

A computer subroutine parameterization of electromagnetic dissociation cross sections for nucleus-nucleus collisions is presented that is suitable for implementation in a heavy ion transport code. The only inputs required are the projectile kinetic energy and the projectile and target charge and mass numbers. Author

N88-23032# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT OF FAST BREEDER REACTORS IN CHINA
Shounan Li *In its* JPRS Report: Science and Technology. China 3 May 1988 p 20-35 Transl. into ENGLISH from Wuli (Beijing, People's Republic of China), v. 16, no. 8, Aug. 1987 p 460; 487-493 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

N88-23033# Joint Publications Research Service, Arlington, Va.
DESIGN OF NUCLEAR HEAT, POWER CO-GENERATION PLANT DETAILED
Jukui Liu *In its* JPRS Report: Science and Technology. China 3 May 1988 p 36-55 Transl. into ENGLISH from He Dongli Gongcheng (Chengdu, People's Republic of China), v. 8, no. 6, Dec. 1987 p 1-13 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N88-23585# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany). Abteilung Optik.
SPECTRAL RADIOMETRY: METHODS, MEASURING TECHNIQUES, AND APPLICATIONS [SPEKTRALRADIOMETRIE: METHODIK, MESSTECHNIK, ANWENDUNG]
Gerhard Vieth, ed. and Heinrich Kaase, ed. Oct. 1986 261 p In GERMAN Presented at the 69th PTB Seminar, Brunswick, Fed. Republic of Germany, 21-22 Oct. 1986
(PTB-Opt-24; ISBN-3-88-314662-5; ISSN-0341-6712; ETN-88-91430) Avail: NTIS HC A12/MF A01

Spectrometry and spectral radiometry are introduced. Dispersive spectral apparatus; an IR spectrometry multiplex method; a heterodyne spectrometer for the frequency range between 300 and 3000 GHz; a position-sensitive photon counting method; spectral radiation measurement using a photodiode receiver; and radiation standards are treated. Requirements for radiation receivers; differential spectral radiometry; a reflection standard for spectroradiometry; UV radiometry; and biological activity spectroscopy are presented. Applications of spectral radiometry in the industrial testing laboratory, meteorology, industrial safety, and materials testing are discussed. For individual titles, see N88-23586 through N88-23601.

N88-23586# Technische Univ., Brunswick (West Germany). Inst. fuer Halbleiterphysik und Optik.
SPECTROMETRY AND SPECTRAL RADIOMETRY [SPEKTROMETRIE UND SPEKTRALRADIOMETRIE]
Franz Rudolf Kessler *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 3-17 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

The spectroscopic method of the correlation analysis of singly counted photons is presented. This method allows a spectral resolving power of 10 to the -15 power. The two theorems on which the correlation spectroscopy is based, namely the Wiener-Khinchin theorem and the Siegert relation, are outlined. Two problems to which correlation spectroscopy can be applied, namely small half-widths and ultrashort light pulses, are discussed. ESA

N88-23587# Zeiss (Carl), Oberkochen (West Germany).
DISPERSIVE SPECTRAL APPARATUS [DISPERSIVE SPEKTRALAPPARATE]
A. Reule *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 18-45 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

Characteristics and evaluation criteria of dispersive spectral apparatus are presented. Monochromators, polychromators, allochromators, dispersive elements, and imaging elements are defined. Angular dispersion, linear dispersion, monochromater bandwidth, spectral slit width, smallest resolvable wavelength difference, resolving power, and curvature of the spectral lines are discussed. Optical conductance, irradiation rate for monochromatic radiation, useful and effective slit width, and monochromator radiated power, are treated. Heterochromatic error radiation, and double monochromators as a means to reduce it, are discussed. ESA

N88-23588# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
MULTIPLEX METHODS IN INFRARED SPECTROMETRY [MULTIPLEXVERFAREN DER INFRAROT-SPEKTROMETRIE]
W. Richter *In its* Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 47-69 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

The use of multiplex methods in IR spectrometry is treated. The increase in signal-to-noise ratio which can be obtained by the multiplex method as compared to the sequential method is explained. The requirement for this increase is that the noise be independent of the signal. This requirement is fulfilled in IR spectrometry. The two most important multiplex methods of IR spectrometry, namely Hadamard and the Fourier spectrometry are described. Measuring examples of Fourier spectrometry are given. ESA

N88-23589# Max-Planck-Inst. fuer Radioastronomie, Bonn (West Germany).
HETERODYNE SPECTROMETER FOR THE VERY HIGH FREQUENCY RANGE BETWEEN 300 AND 3000 GHz (1 mm TO 0.1 mm) USING A MIXER IN OPEN STRUCTURE [HETERODYN-SPEKTROMETER FUER DEN HOECHSTFREQUENZBEREICH 300 GHZ BIS 3.000 GHZ (1 MM BIS 0.1 MM) MIT EINEM MISCHER INOFFENER STRUKTUR]
Hans Peter Roeser *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 70-77 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

Developments of sources, receivers and other components in the frequency band from 300 to 3000 GHz are summarized. The principle of the submillimeter heterodyne receiver is explained. Optically pumped submilliter lasers used oscillators for effective mixing, submillimeter optics, quasi-optical mixers, intermediate frequency components and detectors, and the sensitivity of submillimeter heterodyne spectrometers are discussed. ESA

N88-23590# Justus Liebig-Universitaet, Giessen (West Germany). Inst. fuer Physik.
THE POSITION-SENSITIVE COUNTING OF PHOTONS [POSITIONSEMPFINDLICHES ZAEHLEN VON PHOTONEN]
R. Busch, M. Stiegler, and K.-H. Schartner *In* Physikalisch-Technische Bundesanstalt, Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 78-99 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

Anode structures which can be coupled as position-sensitive multichannel-plate collector electrodes are described. The characteristics and relevant parameters of microchannel-plate chevrons are discussed, covering the spectral range from EUV to visible. Different systems and techniques for reading position information are presented. Position-sensitive-detector (PSD) systems, developed in laboratories, and commercially available systems are compared, from the point of view of applications in the vacuum-UV range. Spectroradiometric applications of PSD systems are given. ESA

N88-23591# Physikalisch-Technische Bundesanstalt, Brunswick (West Germany).
SPECTRAL RADIATION MEASUREMENT USING A PHOTODIODE ARRAY AS RECEIVER [SPEKTRALE STRAHLUNGSMESSUNG MIT EINEM PHOTODIODEN-ARRAY ALS EMPFAENGER]
G. Sauter *In its* Spectral Radiometry: Methods, Measuring Techniques, and Applications Oct. 1986 p 100-113 In GERMAN (For primary document see N88-23585 16-74)
Avail: NTIS HC A12/MF A01

Spectral radiation measurement using photodiode-array polychromators is treated. The frequency range from X-ray to far infrared can be covered. The adaptation of the amplification to the maximum intensities in the spectrum is realized via the illumination time. The uncertainties in the measured signals are determined by light and noise; the latter can be reduced by signal averaging. The photodiode-array measurement is especially suited for fluctuating intensities and single flashes, and is to be preferred for fast measurements and when concessions in resolution and

TM images. The results proved to be valuable and different enhancement procedures were suitable for different observations.
Author

N88-23607# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
TIME-DOMAIN FREQUENCY-SELECTIVE OPTICAL MEMORIES: A STUDY OF THE BASIC MECHANISMS AND POTENTIAL SYSTEMS Final Report, 14 Feb. 1983 - 30 Sep. 1987
Thomas W. Mossberg 21 Dec. 1987 11 p
(Contract DAAG29-83-K-0040)
(AD-A190854; ARO-19983.14-PH) Avail: NTIS HC A03/MF A01 CSCL 09E

Fundamental principles associated with a new non-linear optical approach to constructing ultra-high speed, high density, optical memories have been studied in a four-year ARO research contract. Basic feasibility of the approach has been established. Non-linear optical approaches to optical processing, phase-conjugation, and pulse compression were also investigated. GRA

N88-23608# Stanford Univ., Calif. Physics Lab.
TUNABLE OPTICAL SOURCES/GROWTH AND CHARACTERIZATION OF NONLINEAR OPTICAL MATERIALS Final Report, 1 Aug. 1984 - 31 Oct. 1987
Robert L. Byer and Robert S. Feigelson Jan. 1988 17 p
(Contract DAAG29-84-K-0071)
(AD-A190874; SU-GL-4313; ARO-21327.17-PH) Avail: NTIS HC A03/MF A01 CSCL 20F

Progress in solid-state laser research, nonlinear optical material growth science and nonlinear optical frequency conversion techniques is reported. High quality crystals of silver gallium selenide in lengths up to 3.5 cm are now being grown for nonlinear infrared applications. The growth of barium for ultraviolet and high-intensity visible applications was pursued. With these new materials we have made first demonstrations of optical parametric oscillation and demonstrations of high-average-power frequency conversion capabilities. The stability of the single-axial-mode diode-pumped solid-state lasers is proving vital for the reliable operation of nonlinear optical devices such as CW second harmonic generators and single-mode optical parametric oscillators. Zig-zag slab laser development has continued to provide sources of high-average-power pump radiation. GRA

N88-23609# Martin Marietta Aerospace, Orlando, Fla.
ADAPTIVE SEGMENTATION EVALUATION Final Report, 1 Jan. - 31 Aug. 1987
Ron Patton 24 Sep. 1987 98 p
(Contract DAAL02-85-C-0084)
(AD-A190965; OR-19130) Avail: NTIS HC A05/MF A01 CSCL 20F

Phase 2 of this contract addressed the issue of improving the segmenter performance on military vehicles in infrared imagery through the use of temporal processing techniques. Specific objectives were: (1) develop temporal-based techniques to augment current segmentation algorithms; (2) develop a set of metrics to quantitatively represent segmenter performance in terms of quality and consistency of segmentation; and (3) perform a comparative study of performance results between the modified segmentation approach and the unaided approach. The approach concentrated on developing techniques for image data stabilization through the use of multiframe data integration. The most important aspect of multiframe data integration is its ability to increase frame to frame data stability and reduce noise. These properties have two important consequences: (1) the improved signal quality greatly reduces the need for special purpose processing by each ATR component to overcome the image ambiguities found in the raw data; and (2) features that represent higher levels of structural detail usually masked by noise can be computed for improved object discrimination and classification performance. GRA

N88-23610# Imperial Coll. of Science and Technology, London (England).
ENHANCED BACKSCATTERING FROM ROUGH SURFACES Periodic Report No. 1
J. C. Dainty 9 Oct. 1987 5 p
(Contract DAJA45-87-C-0039)
(AD-A191089) Avail: NTIS HC A02/MF A01 CSCL 20F

Further photoresist surfaces have been prepared, but are not yet fully characterized by Talysurf and optical microscopy. Results of infra-red (10.6 microns) scattering for I sub ss, I sub sp, I sub pp and I sub ps from one of these surfaces are given. This is the first really conclusive piece of evidence that we are getting significantly different behavior for s and p incident polarizations. Curves are given for angles of incidence of 0 and 30 deg. Note the tendency of the cross-polarized return to maximize towards backscatter and the quite different shapes of the I sub ss and I sub pp curves at 30 deg angle of incidence. Although the rms surface height (approx 1 micron) is very much less than one wavelength, the Rayleigh parameter R = (4 pi sigma sub h)/lambda is not small in the perturbation sense. GRA

N88-23611# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
INVESTIGATION OF NON-LINEAR OPTICAL BEHAVIOR OF SEMICONDUCTORS FOR OPTICAL SWITCHING, VOLUME 1 Final Report, 1 Oct. 1984 - 30 Sep. 1986
Joseph H. Simmons 30 Sep. 1987 255 p
(Grant AF-AFOSR-0395-84)
(AD-A191297; AFOSR-88-0133TR-Vol-1) Avail: NTIS HC A12/MF A01 CSCL 20F

Studies were conducted on semiconductor doped filter glasses which have been observed to exhibit third order optical non-linearity. This non-linear optical (NLO) behavior switches on and off in sub-picosecond times. However, the switching time, the NLO coefficient and the operating temperature are affected by the microstructure of the precipitated CdS and CdSe semiconductors. Studies were conducted to examine the crystal microstructures developed in these filter glasses and to correlate them with the optical properties of the semiconductors. There appears to be a potential for an increase in NLO coefficient by a factor of 10 to 1000 with the development of a suitable microstructure. Results and implications of the studies are presented. Studies on thin films of semiconducting CdS showed that microstructure can be controlled by suitable sputtering conditions. Strong exciton transitions were observed and have a high potential for NLO behavior. Composite thin films of CdS semiconducting crystals confined in a glass matrix were formed by co-evaporation. Studies of the phase separation behavior of fluoride glasses were continued in the system: CdF2, LiF, AlF3, PbF2. Two levels of phase separation were observed, consisting of a large microstructure of isolated spheres 3 to 10 micron in diameter, and a very small interconnected microstructure resulting from secondary phase separation. GRA

N88-23612# Indiana Univ., Bloomington. Dept. of Chemistry.
A NEW FIBER-OPTIC-BASED ION SENSOR
Frank V. Bright, Greg M. Poirier, and Gary M. Hieftje 15 Feb. 1988 28 p
(Contract N00014-86-K-0366)
(AD-A191322; INDU/DC/GMH/TR-88-17) Avail: NTIS HC A03/MF A01 CSCL 20F

A fluorimetric fiber-optic-based ion sensor has been developed that employs rhodamine 6G hydrophobically and electrostatically trapped on a Nafion film. The sensor is based on the measurement of quenching or enhancement of rhodamine 6G fluorescence by various ions. It was found that ions like Co(II), Cr(III), Fe(II), Fe(III), Cu(II), Ni(II) and NH4+ rapidly quench the rhodamine 6G fluorescence at an initial rate that depends on the ion concentration. This quenching is then readily reversed by the addition of reverser ions like H+, Li+, Na+, K+, Ba(II), Ca(II), Mn(II), Zn(II) and Mg(II). Again, the initial rate for the attainment of the original fluorescence was found to depend on the reverser ion concentration. Therefore, by monitoring the quenching directly the

concentration of quencher ions can be determined. In addition, by loading the film with quencher and monitoring the initial rate of return toward the original baseline signal, one can quantitate non-quenching ions. GRA

N88-23613# Indiana Univ., Bloomington. Dept. of Chemistry.
A NEW FIBER-OPTIC-BASED PHASE-RESOLVED PHOSPHORESCENCE SPECTROMETER
Frank V. Bright, Curtis A. Monnig, and Gary M. Hieftie 15 Feb. 1988 31 p
(Contract N00014-86-K-0366)
(AD-A191325; INDU/DC/GMH/TR-88-20) Avail: NTIS HC A03/MF A01 CSCL 20F

A new phase-resolved phosphorescence spectrometer is described which employs a cw ultraviolet argon-ion laser excitation source. THe excitation and phosphorescence radiation is carries to and from the sample through inexpensive optical fibers. Typical detection limits are less than 85 nM for all of the lumiphores studied. The new instrument is shown to be applicable to the simultaneous determination of the individual components in binary and ternary mixtures. In addition, the new instrument is used for the generation of multidimensional data sets. Specifically, the phase-resolved phosphorescence intensity vs. detector phase angle setting are collected rapidly (10 minutes) for several of the lumiphores studied. These multidimensional data arrays are subsequently used for multicomponent analyses. GRA

N88-23034# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL INVESTIGATION ON STIMULATED RAMAN SCATTERING IN HIGH-PRESSURE HYDROGEN BY RUBY LASER
Guangqiu Zhang, Junyong Xiao, and Jichun Ma *In its* JPRS Report: Science and Technology. China 3 May 1988 p 76-82 Transl. into ENGLISH from Yingyong Jiguang (Shanghai, People's Republic of China), v. 7, no. 5, Oct. 1987 p 217-220 (For primary document see N88-23030 16-31)
Avail: NTIS HC A08/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-23614# Naval Research Lab., Washington, D.C.
THE EFFECTS OF OPTICAL SMOOTHING TECHNIQUES ON FILAMENTATION IN LASER PLASMAS Memorandum Report, Oct. 1986 - Oct. 1987
Andrew J. Schmitt 29 Dec. 1987 61 p
(AD-A188719; NRL-MR-6142) Avail: NTIS HC A04/MF A01 CSCL 20F

The effect of the Induced Spatial Incoherence (ISI) and the Random Phase Screen (RPS) optical smoothing techniques on the filamentation instability in laser plasmas has been investigated numerically and analytically. A two dimensional time dependent laser plasma propagation code, including both ponderomotive and thermal condition dominated filamentation, is used to simulate the laser plasma interaction. The results of these simulations are compared to the predictions of a simple theory that describes the filamentation of both coherent light and spatially and temporally incoherent light. It is shown that filaments driven by the thermal mechanisms tend to cluster together and produce greater large-scale nonuniformities in the laser illumination than the ponderomotively driven filaments. The RPS optical smoothing technique is found to reduce filamentation only if fast focusing optics (F less than or equal to 5) are used. The ISI smoothing method suppresses filamentation for fast or slow focusing optics, and requires only moderate laser bandwidth (delta omega/omega approx, = 0.1%). In general, the ISI smoothing method provides the best suppression of filamentation. GRA

N88-23615# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
NUMERICAL RESEARCH OF DISPERSION PROPERTIES OF PLASMA CYLINDRICAL WAVEGUIDES LOCATED IN MAGNETIC FIELD
A. K. Berezin, N. M. Zemlyanskij, V. I. Mirnyj, I. N. Onishchenko, and G. V. Sotnikov 1986 20 p In RUSSIAN; ENGLISH summary
(DE87-703009; KFTI-86-25) Avail: NTIS (US Sales Only) HC A03/MF A01

By numerical solution the dispersion properties of metallic waveguides partially filled up with cylindrical plasma or tube plasma of finite wall thickness placed into an infinite heavy magnetic field under different values of plasma density and radius of the conducting shells in studied. A dispersion dependence of cylindrical waveguide, partially filled with plasma and placed into the finite magnetic field, on the magnetic field intensity and on a degree of waveguide filling up with plasma is studied. A radial structure of the electric and magnetic fields of slow plasma wave is considered in such waveguides. It is shown that the control of wave phase of plasma density, and the considerable poynting vector fluxes occur in the range of small values of longitudinal wave number. DOE

N88-23616# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
KINETICS OF ELECTRONS AND MOLECULES AT PLASMA-BEAM DISCHARGE IN MOLECULAR GASES
V. I. Karas, V. V. Mukhin, A. M. Naboka, and V. E. Novikov 1987 14 p In RUSSIAN
(DE88-701196; KFTI-87-18) Avail: NTIS (US Sales Only) HC A03/MF A01

Effect of molecule distribution by oscillating levels on plasma-beam discharge characteristics in molecular gases has been considered. It is shown that under conditions of gas low temperature T<< T sub v and TE sub 1E << epsilon sub 0 the higher rate of a chemical reaction can be obtained under conditions of strong nonequilibricity, i.e., when the larger stage of oscillating molecule energy is in states with strong anharmonicity. Expressions for the length of beam relaxation shaping a plasma-beam charge have been obtained taking into account self-consistently nonequilibricity of molecule distribution by oscillating levels and chemical reaction running. It is shown that the length of beam relaxation increases with the growth of the degree of nonequilibricity distribution by oscillating levels. DOE

N88-23617# Kyoto Univ., Uji (Japan). Plasma Physics Lab.
MEASUREMENTS OF EDGE TURBULENCE WITH LANGMUIR PROBES IN CURRENTLESS HELIOTRON E PLASMAS
H. Zushi, T. Mizuushi, O. Motojima, M. Wakatani, F. Sano, M. Sato, A. Iiyoshi, and K. Uo Jul. 1987 32 p
(DE88-752313; PPLK-R-16) Avail: NTIS (US Sales Only) HC A03/MF A01

A study of microscopic fluctuations of density n tilde and potential PHI tilde in the scrape-off layer is performed. Frequency spectra of n tilde and PHI tilde show a strongly turbulent character as observed in many tokamaks. The fluctuation levels of n tilde/n and ePHI tilde/kT(sub e) are consistent with predictions based on the non-linear collisional drift wave models. Line averaged density and heating power dependences of n tilde/n and ePHI tilde/kT(sub e) are studied in two types of currentless plasmas, namely electron cyclotron resonance heating (ECRH) plasmas and neutral beam injection (NBI) heating plasmas. Their parametric dependency are compared with the trends of the energy confinement time. Finite Beta effects on ePHI tilde(sub f)/kT(sub e) and n tilde/n are discussed. DOE

N88-23618# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
INCORPORATING RELIABILITY INTO THE DESIGN OF EXPERIMENTAL FUSION FACILITIES
L. C. Cadwallader and D. F. Holland 1987 5 p Presented at the 12th Symposium on Fusion Engineering, Monterey, Calif., 12 Oct. 1987

(Contract DE-AC07-76ID-01570)
(DE88-006767; EGG-M-14787; CONF-871007-92) Avail: NTIS HC A02/MF A01

This paper presents risk-based design objectives for the Compact Ignition Tokamak (CIT) and gives ideas for risk reducing design practices that can be incorporated into the CIT design. A preliminary analysis for the identification of critical, nonrepairable CIT components is also presented. DOE

N88-23619# Nagoya Univ. (Japan). Inst. of Plasma Physics.
PROCEEDINGS OF SYMPOSIUM ON PHYSICS OF TARGET IMPLOSION AND PULSED POWER TECHNIQUES
Keishiro Niu, ed. Feb. 1988 347 p Symposium held in Yokohama, Japan, 30 Sep. - 1 Oct. 1987
(IPPJ-859; ISSN-0469-4732) Avail: NTIS HC A15/MF A01

Topics addressed include: fuel implosion; numerical analysis for irradiation effects on target implosion; ion beam propagation; particle simulation; plasma channel stability; particle acceleration; particle trapping; radiative energy transfer; target design; high parameter plasma models; irradiation of laser targets; anode plasma behavior; and beam diodes. For individual titles, see N88-23620 through N88-23643.

N88-23620# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Energy Sciences.
ANALYSIS FOR FUEL IMPLOSION IN ICF TARGET AND PELLET GAIN
Keishiro Niu, Takayuki Aoki, and Hiroshi Takeda *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 1-16 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

A power plant to extract 1 GW electric output power is proposed. After the properties of the DT fuel is examined, the compression and the heating of the fuel in the target due to the implosion motion is analyzed. The optimized parameters of the target is investigated for extracting the maximum fusion energy. Author

N88-23621# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Energy Sciences.
NUMERICAL ANALYSIS FOR EFFECTS OF IRRADIATION NONUNIFORMITIES ON TARGET IMPLOSION
Hiroshi Takeda and Keishiro Niu *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 17-37 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Effects of irradiation nonuniformities on target implosion and ignition conditions for inertial confinement fusion with ion beams are studied by using a 2-dimensional code. The following results are then obtained. When the beam energy is 5 MJ which is 1.6 times the threshold beam energy (=3.2 MJ) in the spherical symmetric case, ignition occurs if the peak-to-valley nonuniformity rate is smaller than 0.05. On the other hand, this value rises up to 0.1 when the beam energy is 7 MJ, i.e., it is 2.2 times the threshold beam energy in the spherical symmetric case. Furthermore, the ignition condition is the severest for the nonuniformity with the largest spatial. Author

N88-23622# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Energy Sciences.
DEVELOPMENT OF ELECTROMAGNETIC PIC CODE FOR LIB DIODE
Katsuhiko Ozaki and Keishiro Niu *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 38-45 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

A 2.5 dimensional particle-in-cell code is being developed to design high intensity LIB diodes for inertial confinement fusion. The fundamental equations consist of three wave equations, one Poisson equation for determining the electromagnetic field, and Newton-Lorentz equations for moving particles. In this code, cylindrical coordinates are used. In the first step the PIC code tries to simulate a simple model which is a parallel circular plane diode, and to investigate ion current density at the cathode. Author

N88-23623# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Energy Sciences.
KINETIC THEORETICAL ANALYSIS FOR PROPAGATION OF ROTATING ION BEAM IN ICF
T. Kaneda and K. Niu *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 46-55 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

It is proposed that a self-magnetic field of the beam can stabilize and pinch itself, without complete neutralization of the beam current. This situation is achieved in the background plasma which has a density about 1/10 of the beam. The beam produces the strong azimuthal self-magnetic field by its axial motion. This field makes the beam pinch. The axial self-magnetic field is induced by the beam azimuthal motion and stabilized the beam propagation. The rotating light ion beam is discussed on the basis of kinetic theory. The velocity distribution function for the beam ions f sub b0 is obtained as an exact solution of the Vlasov-Maxwell equation for steady state. That is, f sub b0 is an arbitrary function with respect to the Hamiltonian H, canonical angular momentum P sub theta, and canonical axial momentum P sub Z; f sub b0 = f sub b0(H,P sub theta, P sub Z). Here the subscript 0 denotes the steady state. The macroscopic physical quantities are obtained by integration in v-space. Hence, in order to obtain the steady state solution of beam-plasma system, these equations must be solved numerically with Maxwell equations simultaneously. The distribution function f sub b0 is assumed by considering the condition to extract the beam in the diode. Author

N88-23624# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Energy Sciences.
HYBRID PARTICLE SIMULATION FOR FOCUSING OF ROTATING AND PROPAGATING LIB
Takayuki Aoki and Keishiro Niu *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 56-77 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The focusing processes of a rotating and propagating light ion beam in the drift region are studied numerically by using a hybrid particle code. Initially an intense ion beam with current density of 8 kA/sq cm and the total current of 2.5 MA, which is extracted from the diode, passes through the applied magnetic field to make the beam rotate in the azimuthal direction. The beam is focused owing to the anode geometry and the induced self-magnetic field. The phenomena of the beam focusing strongly depends on both the background plasma pressure of the drift region and the applied magnetic field. In the case where the plasma pressure is 3.0 Torr and the 0.2-Tesla magnetic field is applied in the distance of 2.0 cm, the self-magnetic field is induced in the vicinity of the focal spot, and the rotating and propagating beam with the intensity of 108 TW/sq cm and the beam radius of 3.5 mm is formed after the focal spot. Author

N88-23625# Waseda Univ., Tokyo (Japan). Department of Applied Physics.
ELECTRON CURRENT EFFECT ON STABILITY OF PLASMA CHANNEL
Tomokazu Kato and Tetsuya Ishimoto *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 78-80 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The density profile of each species was investigated when the beam propagates in a plasma channel. Assuming the cylindrical symmetry and uniformity in the z-direction for the ion beam and the plasma channel, the profile depends only on the radial distance

from the axis of symmetry. The channel ion is treated as at rest, and there are two flows in the channel, electron return current and beam flow. Only the magnetic field contributes to the density profile because of charge neutrality. Two cases were considered, one in which the pressure balance with the Lorentz force, and the other in which the profile is constant. The considered combination of the electrons and the beam profile is as follows: both the ion beam and the electron current are in equilibrium; the ion beam is in equilibrium and the electron density profile is constant; the beam density profile is constant and the electrons are in equilibrium; and both profiles are constant. The validity of the assumption of the thermal equilibrium is discussed. Author

N88-23626# Nagaoka Technological Univ., Niigata (Japan). Faculty of Engineering.
NUMERICAL SIMULATION FOR PARTICLE ACCELERATION AND TRAPPING BY AN ELECTROMAGNETIC WAVE
Shigeo Kawata, Masami Matsumoto, and Yukio Masubuchi *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 81-101 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The interaction between particles and an electromagnetic (EM) wave is investigated numerically in the system of particle V sub p x B acceleration by the EM wave. Numerical simulations show that the particle acceleration mechanism works well in the case of the appropriate number d density of the imposed particle. When the interaction between particles and the wave is too strong, a part of the trapped and accelerated particles is detrapped. A condition is also presented for the efficient particle acceleration and trapping by the EM wave. Author

N88-23627# Polytechnical Univ. of Madrid (Spain). Inst. de Fusion Nuclear.
SIMULATION CODE FOR ICF INCLUDING RADIATIVE ENERGY TRANSFER
G. Velarde, J. M. Aragones, J. J. Honrubia, J. M. Martinez-Val, E. Minguez, J. L. Ocana, and J. M. Perlado *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 102-112 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Improvements in the atomic physics environment or the Inertial Confinement Fusion (ICF) code NORMA, together with algorithms for radiation transport are presented. Using that code, results on LHAR targets of ILE are reported and compared with ILESTA and HISHO-1D codes. Author

N88-23628# Nagaoka Technological Univ., Niigata (Japan).
NUMERICAL ANALYSIS OF TARGET IMPLOSION IN LIB ICF
Yukio Masubuchi and Shigeo Kawata *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 113-123 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The numerical analysis for the target implosion using uniform and nonuniform beams is presented. In the analysis a very simple model is assumed and the 2-dimensional hydrodynamic code called HALLEY is used. Author

N88-23629# Osaka Univ., Suita (Japan). Inst. of Laser Engineering.
PUSHERLESS IMPLOSION, PULSE TAILORING AND IGNITION SCALING LAW FOR LASER FUSION
K. Mima, H. Takabe, and S. Nakai *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 124-139 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The conventional implosion scheme for high gain and high density compression depends upon piston action of an accelerated heavy pusher. However, the contact surface between the pusher and the fuel layer is very unstable in the stagnation phase. The laser pulse tailoring and the scaling laws for pellet gain and fuel pR are discussed under the condition of the very weak piston action of the pusher. The scaling laws indicate that the fuel will be ignited by 100 kJ, 0.35 micron wavelength laser irradiation. Author

N88-23630# Osaka Univ., Suita (Japan). Inst. of Laser Engineering.
EFFICIENT SHELL IMPLOSION AND TARGET DESIGN
M. Murakami, K. Nishihara, and H. Takabe *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 140-159 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

An analytical model was developed which described the implosion property of high-aspect-ratio targets. As a result, it was shown that the hydrodynamic and transfer efficiencies, and consequent coupling efficiency and ion temperature can be expressed as a function of the aspect ratio. Optimum target design, regarding the aspect ration and the initial radius, can be found with this theory. Furthermore, this theory was examined by comparing it with a large amount of experimental data to show its validity. Also, the theory developed reproduced the simulation results. The modeling to obtain the plasma parameters at peak compression, which is composed of shock and adiabatic compressions, is a simple one and not especially new. However, the important point is that equation 17, which determines the final condition of the plasma, includes the coupling efficiency as a function of the aspect ratio. That is why plasma parameters such as neutron yield are obtained explicitly as a function of the aspect ratio. The reduction of neutron yields from one dimensional analysis can be explained by considering the Rayleigh-Taylor instability in the deceleration phase, which is related to the nonuniformities of the shell thickness and/or the absorption. Author

N88-23631# Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Applied Physics.
MICROINSTABILITIES IN ION BEAM PROPAGATION
Toshio Okada and Keishiro Niu *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 160-163 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Microinstability for a rotating light ion beam (LIB) fusion system is investigated. Stability conditions including the effects of fractional current neutralization, rotation of LIB, and beam temperature are derived for propagation through a background plasma. The results are illustrated by examining the various parameters of a rotating proton beam propagating in a plasma. Author

N88-23632# Technical Univ. of Prague (Czechoslovakia). Faculty of Nuclear Science and Physical Engineering.
SOME ASPECTS OF THE UNIFIED MODEL OF NON-IDEAL HIGH-PARAMETER PLASMAS: ELECTRON EOS AND CONDUCTION COEFFICIENTS
L. Drska and J. Vondrasek *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 164-184 Sponsored by the Japan Society for the Promotion of Science (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Two partial models applied in atomic physics subpackages used in numerical simulations of pulsed-source-driven, non-ideal high-parameter plasmas are presented: electron EOS model and the model for electron conductivity coefficient calculations. The EOS model used Dharma-Wardana exchange and correlation correction depending on both electron density and temperature. The electron thermal and electrical conductivity calculations are based on the Balescu-Lenard equation. Author

N88-23633# Osaka Univ., Suita (Japan). Inst. of Laser Engineering.
STABILITY REQUIREMENT FOT IGNITION AND HIGH GAIN IMPLOSION = 2-D SIMULATION FOR HIGH NEUTRON YIELD EXPERIMENT =
H. Takabe *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 185-192 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Implosion stability is the essential problem for Inertial Confinement Fusion (ICF) scenario, in which ignition by use of a 100 kJ class driver will be demonstrated and the pellet gain 100 will be realized with MJ class driver. In order to study the stability requirement, a two dimensional fluid code, ILESTA-2D was developed. Preliminary results obtained by using the 2-D code to simulate the recent high neutron yield experiment by Gekko-XII are reported. It is found that the neutron yield is rather insensitive to the implosion with relatively smaller wavenumber nonuniformity. Author

N88-23634# Polytechnical Univ. of Madrid (Spain). E.T.S.I. Aeronauticos.
CORONAL FLUID-DYNAMICS IN LASER FUSION
Juan R. Sanmartin *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 198-212 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The fluid-dynamics of the corona ejected by laser-fusion targets in the direct-drive approach is discussed. A two-fluid model involves inverse bremsstrahlung absorption, refraction, different ion and electron temperatures with energy exchange, different ion and electron velocities and magnetic field generation, and their effect on ion-electron friction and heat flux. Four dimensionless parameters determine coronal regimes for one-dimensional flows under uniform irradiation. One additional parameter is involved in two-dimensional problems, including the stability of one-dimensional flows, and the smoothing of nonuniform driving. Author

N88-23635# Seville Univ. (Spain). Dept. of Thermo and Fluid Mechanical Engineering.
SELF-SIMILAR EXPANSIONS IN ION BEAM FUSION
A. Barrero and A. Fernandez *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 213-234 Submitted for publication (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The self-similar expansion generated by an intense light ion beam pulse of energy per nucleon E sub b = E sub o (t/pi) sup rho and current intensity I sub b = I sub o (t/pi) sup 2p -1 (0 is less than t is less than pi) impinging on a planar target is considered. The structure of the expansion flow is analyzed and profiles of beam density and velocity and density, velocity and temperature of the plasma are found from the analysis. Quantities of interest in inertial confinement fusion such as the ablation pressure and the mass ablated rate as functions of time for several values of the law time exponent p are obtained. The acceleration efficiency of thin foils, defined as the fraction of absorbed energy that goes to foil kinetic energy as the function of p was also calculated. Author

N88-23636# Osaka Univ., Suita (Japan). Inst. of Laser Engineering.
FINITE ION-RELAXATION AND NONEQUILIBRIUM RADIATION EFFECTS ON LASER-DRIVEN IMPLOSIONS
T. Yabe and K. A. Tanaka *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 234-249 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The implosion dynamics of recent experiments with high aspect-ratio laser-driven targets are re-examined by taking account of finite mean free paths of the ion. The mean free path is found to be comparable to the fuel size and this can cause a significant departure from a fluid-like description. One of the such effects stemming from the finite mean free path of the ion, real viscosity, seriously changes the results; the compression ratio becomes 5 times smaller with this real viscosity. In addition to this, inclusion of non-local thermodynamic equilibrium (LTE) atomic process is shown to critically determine the implosion dynamics. Author

N88-23637# Osaka City Univ. (Japan). Research Inst. for Atomic Energy.
GENERATION OF HIGH BRIGHTNESS ION BEAM FROM INSULATED ANODE PED
Yoshinobu Matsukawa *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 250-255 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Generation and focusing of a high density ion beam with high brightness from an organic center part of the anode of a PED was reported previously. Mass, charge and energy distribution of this beam were analyzed. Three kinds of anodes were tried. Many highly ionized medium mass ions accelerated to several times of voltage differences between the anode and cathode were observed. In the case of all insulator anodes the current carried by the medium mass ions is about half of that carried by the protons. Author

N88-23638# Kobe Univ. of Mercantile Marine (Japan). Dept. of Nuclear Engineering.
THE APPLICATION OF RUTHERFORD BACKSCATTERING FOR ANALYZING MULTILAYERED STRUCTURE CHANGE INDUCED BY PULSED ION BEAM BOMBARDMENT
N. Sasaki, N. Takagi, and S. Yano *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 256-271 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

Using the proton backscattering technique, plane-shaped samples consisting of a double layered film Pb/parylene (polyparaxylene) chemically deposited on a silicon plate were analyzed after bombarded by pulsed proton beams of about 400 keV with different current densities up to 1 kA/sq cm. Very clear backscattering spectra were obtained which indicated changes of the layer-structure caused by Light Ion Beams (LIB) bombardment. Almost all the Pb-layer was ablated, and the boundary between parylene and silicon became diffusive. This method proved to be very useful for analysis of LIB bombarded samples. Author

N88-23639# Nagaoka Technological Univ., Niigata (Japan). Lab. of Beam Technology.
TWO-DIMENSIONAL FOCUSING OF SELF-MAGNETICALLY INSULATED PLASMA FOCUS DIODE
Katsumi Masugata, Hironobu Isobe, Keigo Aga, Masami Matsumoto, Shigeo Kawata, and Kiyoshi Yatsui *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 272-289 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

A simple type of self-magnetically insulated vacuum ion diode name the plasma focus diode was successfully developed with a large solid angle of irradiation and low divergence angle. The diode has a pair of coaxial cylindrical electrodes similar to Mather type plasma focus device. Ion-current density of 1.9 kA/sq cm was obtained at the anode surface under the experimental conditions of diode voltage of approximately 1.4 MV, diode current of approximately 180 kA, and pulse width of approximately 75 nsec. The ion beam generated was two-dimensionally focused (line focused) with the focusing radius of approximately 0.18 mm, giving the maximum ion current density and beam power density at the axis to be approximately 130 kA/sq cm and approximately 0.19 TW/sq cm, respectively. The motion of the electrons in the

gap was numerically simulated by use of the developed particle-in-cell computer simulation code, and good agreement was obtained between the simulation and the experiment. Author

N88-23640# Tokyo Inst. of Tech., Yokahama (Japan). Dept. of Energy Sciences.
RESEARCH ON ANODE PLASMA BEHAVIOR OF FLASHOVER PULSED ION SOURCES
H. Yoneda, H. Tomita, K. Horioka, and K. Kasuya *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 290-300 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The physical parameters of anode plasma in a magnetically insulated pulsed ion diode with various diagnostic tools were measured. The result denotes that a large amount of neutral gas particles are emitted in diode operation, and it has an important role on the determination of anode plasma characteristics and the diode performance. Author

N88-23641# Nagaoka Technological Univ., Niigata (Japan). Lab. of Beam Technology.
TIME-RESOLVED SPECTROSCOPIC MEASUREMENT OF ANODE PLASMA IN MAGNETICALLY-INSULATED DIODE
Yasunori Kawano, Norihide Yumino, Yuhzo Araki, Katsumi Masugata, and Kiyoshi Yatsui *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 201-315 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

A diagnostic technique was developed for the time-resolved spectroscopic measurement of anode plasma in a single-current-feed magnetically insulated ion diode. From the measurement of Stark broadening of the H alpha line of hydrogen, the electron density was estimated to be 4 to approximately 5 x 10 to the 16th/cu cm using the pulse-power generator, ETIGO-1, typically operated with diode voltage = 550 and 600 kV, diode current = 36 and 53 kA, and pulse width of approximately 90 ns (FWHM of diode current). Assuming local thermodynamic equilibrium, the electron temperature was estimated to be 1.9 to approximately 2.4 eV from the measurement of light intensity ratio of successive ionization stages of carbon. The expansion velocity of the anode plasma was found to be 4 to approximately 4.5 cm/microsec. Author

N88-23642# Tokyo Inst. of Tech. (Japan). Dept. of Energy Sciences.
STUDY ON THE FLASHOVER ION DIODE WITH CRYOGENIC ANODE
K. Horioka, H. Yoneda, and K. Kasuya *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 316-329 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

The recent experimental issues to clarify the behavior of acceleration gap of flashover type magnetically insulated diodes are shown. The main issues are to investigate the cause of impurity of the extracted beam and to examine the effect of neutral particles on the impedance characteristics of the diode. A magnetically insulated diode which has a cooled anode is used for the experiment. Author

N88-23643# Yamanashi Univ., Kofu (Japan). Faculty of Engineering.
HIGH PRESSURE OPERATION OF BEAM DIODES FOR GENERATING RELATIVISTIC ELECTRON BEAMS
Hidenori Matsuzawa and Tetsuya Akitsu *In* Nagoya Univ., Proceedings of Symposium on Physics of Target Implosion and Pulsed Power Techniques Feb. 1988 p 330-341 (For primary document see N88-23619 16-75)
Avail: NTIS HC A15/MF A01

A beam diode was operated successfully at a pressure as high as 0.1 to approximately 0.01 Torr of gases (He, H2, Ne, N2, CO2, and SF6). Each gas had its optimum pressure P sub m at which electron beam currents were higher in peak values than those for conventional in-vacuum operation by a factor of 1.5 or more. A relationship P sub m x sigma sup 1.18 sub H = constant was obtained where sigma sub H is the total ionization cross sections in gases at some hundred keV. A model was proposed for such operations, and those high pressure operations are preferrable to the conventional if one needs higher currents. Author

N88-23644# Foreign Applied Sciences Assessment Center, La Jolla, Calif.
SOVIET MAGNETIC CONFINEMENT FUSION RESEARCH
R. C. Davidson, L. A. Berry, R. A. Ellis, R. D. Hazeltine, J. T. Hogan, R. S. Post, and W. M. Stacey Oct. 1987 247 p
(PB88-182316; FASAC-TAR-4020) Avail: NTIS HC A11/MF A01 CSCL 20I

This assessment of Soviet fusion research concentrates on the period from 1980-81 through June 1987. The technical accomplishments during this period are reviewed, and the Soviet capabilities and outlook for future contributions are assessed. Detailed evaluations of Soviet accomplishments and capabilities are provided in the areas of basic and applied plasma physics, tokamak confinement technology and engineering, alternate confinement approaches, and fusion computations. Author

N88-23645# Oak Ridge National Lab., Tenn. Fusion Engineering Design Center.
REMOTE MAINTENANCE DESIGN ACTIVITIES AND RESEARCH AND DEVELOPMENT ACCOMPLISHMENTS FOR THE COMPACT IGNITION TOKAMAK
P. T. Spampinato 1988 19 p Presented at the International Symposium on Fusion Nuclear Technology, Tokyo, Japan, 10 Apr. 1988
(Contract DE-AC05-84OR-21400)
(DE88-006980; CONF-880417-2) Avail: NTIS HC A03

The use of deuterium-tritium (D-T) fuel for the Compact Ignition Tokamak (CIT) requires the use of remote handling technology to carry out maintenance operations. The remote operations consist of removing and replacing such components as first wall armor protection tiles, radio-frequency (RF) heating modules, and diagnostic modules. The major pieces of equipment being developed for maintenance activities internal to the vacuum vessel include an articulated boom manipulator (ABM), an inspection manipulator, and special tooling. For activities external to the vessel, the equipment includes a bridge-mounted manipulator system, decontamination equipment, hot cell equipment, and solid radiation-waste (rad-waste) handling and packaging equipment. The CIT Project is completing the conceptual design phase; research and development (R and D) activities, which include demonstrations of remote maintenance operations on full-size partial mock-ups are under way. DOE

N88-23646# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
CORPUSCULAR PLASMA DIAGNOSTICS COMPLEX ON A TOKAMAK WITH A STRONG FIELD
A. I. Kislyakov, A. V. Krasilnikov, M. P. Petrov, and A. N. Romannikov 1987 16 p In RUSSIAN
(DE88-701576; IAE-4460/7) Avail: NTIS (US Sales Only) HC A03/MF A01

A project of corpuscular diagnostics complex for a tokamak with a strong field is considered. The complex comprises atomic particle analysers of several types and a neutral atom diagnostics injector DINA-4. Mathematical model for calculation of neutrals concentration distribution in the tokamak plasma with diagnostic beam and without it is proposed. Based on this model, charge-exchange atom spectra, recorded by corpuscular analysers, are produced, the complex capabilities, physical problems, which may be solved, using this complex, are determined. DOE

N88-23647# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
ON SELFSIMILAR THERMONUCLEAR IGNITION OF A PLASMA IN NECKS OF ZETA DEVICES
V. V. Neudachin and P. V. Sasorov 1987 16 p In RUSSIAN
(DE88-701640; ITEF-129(1987)) Avail: NTIS (US Sales Only) HC A03/MF A01

A problem of thermonuclear ignition of a plasma in necks of zeta devices is considered. It is shown that in the initial power distribution of the DT mixture density both in the framework of hydrodynamics and kinetic Boltzman-Vlasov equations, the thermonuclear ignition distribution can be of a selfsimilar character. The problem with spherically symmetric initial density distribution is investigated in detail in the framework of ideal hydrodynamics with local alpha -particle energy release. The critical value rho(r) found in this case turns out to be equal to 0.25 g/sq cm. Prolonged ignition distribution is impossible at less than rho. DOE

N88-23648# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
NONLINEAR DYNAMICS OF INTERACTION BETWEEN CHARGED PARTICLES MODULATED BEAM AND BOUNDED PLASMA REGULAR OSCILLATIONS
V. A. Balakirev and A. O. Ostrovskij 1987 6 p In RUSSIAN
(DE88-701681; KFTI-87-17) Avail: NTIS (US Sales Only) HC A02/MF A01

The dynamics of density modulated charged particle flux interaction with the oscillations of a plasma resonator have been investigated. It is shown that when the resonator length is comparable with the reversed spatial increment the stationary state is not established. The wave amplitude oscillates periodically. DOE

N88-23649*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
SPACE PLASMA CONTACTOR RESEARCH, 1987 Annual Report, 1 Jan. 1987 - 1 Jan. 1988
Paul J. Wilbur Jan. 1988 87 p
(Grant NAG3-776)
(NASA-CR-182148; NAS 1.26:182148) Avail: NTIS HC A05/MF A01 CSCL 20I

A simple model describing the process of electron collection from a low pressure ambient plasma in the absence of magnetic field and contactor velocity effects is presented. Experimental measurments of the plasma surrounding the contactor are used to demonstrate that a double-sheath generally develops and separates the ambient plasma from a higher density, anode plasma located adjacent to the contactor. Agreement between the predictions of the model and experimental measurements obtained at the electron collection current levels ranging to 1 A suggests the surface area at the ambient plasma boundary of the double-sheath is equal to the electron current being collected divided by the ambient plasma random electron current density; the surface area of the higher density anode plasma boundary of the double-sheath is equal to the ion current being emitted across this boundary divided by the ion current density required to sustain a stable sheath; and the voltage drop across the sheath is determined by the requirement that the ion and electron currents counterflowing across the boundaries be at space-charge limited levels. The efficiency of contactor operation is shown to improve when significant ionization and excitation is induced by electrons that stream from the ambient plasma through the double-sheath and collide with neutral atoms being supplied through the hollow cathode. Author

N88-23650# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
THE TWO-DIMENSIONAL ONE COMPONENT PLASMA IN A DOUBLY PERIODIC BACKGROUND: EXACT RESULTS Interim Technical Report
Francoise Cornu, Bernard Jancovici, and Lesser Blum 24 Jan. 1988 37 p
(Contract N00014-81-0776)
(AD-A191260; TR-30) Avail: NTIS HC A03/MF A01 CSCL 20I

A new method is used to find that the two-dimensional one-component plasma in a inhomogenous background is a solvable model, in equilibrium classical statistical mechanics, for the special value Gamma = 2 of the coupling constant, for a larger class of background shapes: the n-body densities can be explicitly computed. In particular, we can deal with a doubly periodic background; this is a classical model for a crystal mode of fixed ions and mobile electrons. At Gamma = 2, this system is a conductor: the correlations have a fast decay, and the Stillinger-Lovett screening sum rule is obeyed. GRA

N88-23651# Indiana Univ., Bloomington. Dept. of Chemistry.
THOMSON SCATTERING FOR DETERMINING ELECTRON CONCENTRATIONS AND TEMPERATURES IN AN INDUCTIVELY COUPLED PLASMA. 1: ASSESSMENT OF THE TECHNIQUE FOR A LOW-FLOW, LOW-POWER PLASMA
Kim A. Marshall and Gary M. Hieftje 15 Feb. 1988 26 p
(Contract N00014-86-K-0366)
(AD-A191323; INDU/DC/GMH/TR-88-18-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 20I

Electron number densities and electron temperatures have been measured by multichannel Thomson scattering in a low-flow low-power inductively coupled plasma (ICP). Preliminary electron-concentration values agree well with those previously determined, and spatial variation in both electron concentration and temperature are largely consistent with existing models of the ICP. One difference is that aqueous aerosol was found here to depress the electron number density throughout the plasma. Unfortunately, the intensities measured in the wings of the Thomson-scattering spectrum show large uncertainties, making data analysis difficult and the measured electron temperatures less reliable than desired. GRA

N88-23652# Indiana Univ., Bloomington. Dept. of Chemistry.
THOMSON SCATTERING FOR DETERMINING ELECTRON CONCENTRATIONS AND TEMPERATURES IN AN INDUCTIVELY COUPLED PLASMA. 2: DESCRIPTION AND EVALUATION OF A MULTICHANNEL INSTRUMENT
Kim A. Marshall and Gary M. Hieftje 15 Feb. 1988 46 p
(Contract N00014-86-K-0366)
(AD-A191324; INDU/DC/GMH/TR-88-19-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 20I

A new instrument was assembled to measure Thomson scattering from an inductively coupled plasma. Unlike previous designs, the new system employs a fiber-optic array to measure simultaneously up to 12 channels on a Thomson-scattering spectrum. Shutters enable either side of the nominally symmetrical Thomson spectrum to be examined, or permit summing equally spaced channels on opposite sides of the spectrum from the incident laser wavelength. A central channel, used to monitor Rayleigh scattering, enables a simultaneous determination of true gas-kinetic temperatures. Photodetector fatigue is avoided through a rotating mirror that serves as an optical shutter while individual gated integrators attached to each detector minimize the detection of background radiation from the plasma. The new instrument offers high stray-light rejection capability and provides measurements whose precision is photon-limited. Results obtained with the new instrument are presented in a companion paper. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-23653# Israel Atomic Energy Commission, Yavneh. Nuclear Research Center.

ELECTRICAL AND OPTICAL PROPERTIES OF Hg/SUB 1-x/Cd/SUB x/Te DOPED LAYERS GROWN BY LIQUID PHASE EPITAXY (LPE) Ph.D. Thesis

Gabby Sarusi May 1987 116 p In HEBREW; ENGLISH summary

(DE88-701023; IA-1429) Avail: NTIS (US Sales Only) HC A06/MF A01

Liquid Phase Epitaxy (LPE) layers were doped during growth. The growth method was horizontal sliding in semiclosed hydrogen atmosphere. The dopants were copper for p-type layers and gallium for n-type layers.The Two Carrier Model was employed to analyse the results. By this analysis, hole concentration and mobility and electron concentration and mobility were obtained. The transmission infrared spectrum of these layers was examined in the range of 2 to 25 microns. It was demonstrated that the control of the type and carrier concentration can be achieved by doping during growth. Possible application of this work is the ability of production of p-n heterojunctions during growth. The effect of shift in lambdaco to short wavelengths by Burstein Shift can be used as intrinsic infra-red windows. The strong dependence of reflection on wavelengths and carrier concentration demonstrated in this work, can be used in development of infrared waveguides. DOE

N88-23654# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

LONG-TIME TUNNELING IN AMORPHOUS METALS AT HELIUM TEMPERATURES

M. Kolac, B. S. Neganov, A. Sahling, and S. Sahling 1986 14 p In RUSSIAN; ENGLISH summary Submitted for publication

(DE88-701150; JINR-E-8-86-103) Avail: NTIS (US Sales Only) HC A03/MF A01

Long time heat release in amorphous Co sub 69 Fe sub 4.5 Cr sub 2.5 B sub 22 and Fe sub 80 B sub 14 Si sub 6 after cooling from T sub 1 (3.12 K less than or equal to T sub 1 less than or equal to 292 K) to T sub 0 =1.3 K was measured. The power released is proportional to t sup -1 (0.5 h greater than t greater than 60 h). At low T sub 1 the experimental results are in good agreement with the standard tunneling theory. The resulting densities of states of two level systems are close to those in quartz glass. For high T sub 1, observed heat release may be explained assuming the existence of a maximum energy in the distribution function. DOE

N88-23655# Naval Research Lab., Washington, D.C.

HIGH TEMPERATURE SUPERCONDUCTIVITY Final Report

Michael Osofsky 14 Dec. 1987 18 p

(AD-A190259) Avail: NTIS HC A03/MF A01 CSCL 20C

After the initial discovery of superconductivity over 30 K in the La2-XBaXCuO4 system several groups confirmed the result both resistively and magnetically (flux expulsion). Ultimately, transitions were observed in the analagous compounds with Ba replaced with Ca7 and Sr 7.8 for 0.1 less than or equal to X and less than or equal to 0.3 with the highest Tc's above 40 K. Our samples were prepared from regent grade powders of La2O3, BaCo3, SrCO3, CaCO3, PbO2, and CuO. The powders were mixed in appropriate ratios and calcined in air between 1000 C and 1100 C for 12 hours. The resulting materials were reground, pressed into small disks (nominally 1 cm diameter by 2 mm height) and sintered in air at 1000 C to 1100 C for 12 hours. The calcined powders and sintered pellets were X-rayed following each process to ensure that the proper phase was present. GRA

N88-23656# Harry Diamond Labs., Adelphi, Md.

LOCAL DENSITY OF STATES IN DOUBLE-BARRIER RESONANT TUNNELING STRUCTURES Interim Report, Dec. 1986 - Apr. 1987

Thomas B. Bahder, John D. Bruno, Ralph G. Hay, and Clyde A. Morrison Feb. 1988 19 p

(DA Proj. 1L1-61101-A9-1A)

(AD-A190673; HDL-TR-2132) Avail: NTIS HC A03/MF A01 CSCL 20J

We calculate the local density of states between the barriers of a double-barrier resonant tunneling structure within the context of a simplified model. As the area of the barriers increases, there is a smooth crossover in the density of states from a three-dimensional square root of energy behavior to a two dimensional step-like behavior. The local one-dimensional density of states corresponding to a fixed electron momentum transverse to the barriers is also calculated and shows sharp peaks at energies corresponding to the quasi-bound states between the wells. The width of the lowest quasi-bound state is computed as a function of barrier area. GRA

N88-23657# National Academy of Sciences - National Research Council, Washington, D. C. Commission on Engineering and Technical Systems.

DOE (DEPARTMENT OF ENERGY) NATIONAL LABORATORIES AND THE SEMICONDUCTOR INDUSTRY: CONTINUING THE JOINT PLANNING Final Report

1987 39 p Workshop held in Albuquerque, N. Mex., 26-28 May 1987

(PB88-170295) Avail: NTIS HC A03/MF A01 CSCL 20L

The extensive capabilities, expertise, and existing activities of the national laboratories of the U.S. Department of Energy could make a significant contribution to the technical needs of the U.S. semiconductor industry. During a May 1987 workshop at Sandia National Laboratories, representatives of the national laboratories and the semiconductor industry identified a broad range of specific technical areas for collaborative research. These technologies can be grouped in the categories of: patterning and metrology; interconnects and packaging; thin films and pattern transfer; reliability failure and yield analysis; compound seniconductors; and automation and facilities. In each category. specific industry needs were identified and the laboratories with the most advanced capabilities in each technology were named to lead potential collaborative reserach porgrams. The workshop was successful in identifying a number of specific research topics suitable for future collaborative research between the semiconductor industry and the national laboratories. The workshop demonstrated that linkages exist between industrial technical needs and the national laboratories' capabilities. GRA

N88-23658# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et d'Analyse des Systemes.

INITIAL STAGES OF MOLECULAR BEAM HETEROEPITAXIAL GROWTH IN GaAs-(Ca,Sr)F2 AND GaAs/Si SYSTEMS Ph.D. Thesis - Institut Nartional des Sciences Appliquees de Toulouse

Jean Castagne (Institut National des Sciences Appliquees de Lyon, Villeurbanne, France) 1987 145 p In FRENCH; ENGLISH summary

(LAAS-87-355; ETN-88-92009) Avail: NTIS HC A07/MF A01

The lattice matched (Ca,Sr)F2/GaAs deposits and (Ca,Sr)F2/Si deposits with a mismatch of 5 percent are investigated by Auger electron spectroscopy and electron diffraction. The two-dimensional Stranski Krastanov type growth mode, the nature of fluoride growth, and the epitaxial relationships are clearly demonstrated as a function of the sample orientation, either (111) or (100). The growth of GaAs is further studied depositing a fine amorphous film of GaAs and subsequent thermal treatment. The epitaxial growth tends in such conditions to a two dimensional mechanism. The crystallographic characteristics of the so grown first layers are then established. ESA

N88-23659# Sandia National Labs., Albuquerque, N. Mex.
RADIATION EFFECTS IN SILICON Summary Report
H. J. Stein 1988 4 p Presented at the Task Force Meeting on Radiation Effects at the Superconducting Super Collider, Berkeley, Calif., 7 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-006642; SAND-88-0420C; CONF-880356-1) Avail: NTIS HC A02/MF A01

Semiconductor device characteristics are strongly dependent upon the macroscopic properties of the active materials. Semiconductor material properties of particular interest are: majority charge carrier concentration, minority carrier lifetime and charge carrier mobility. Silicon, due to favorable properties in addition to availability and processability, is used in a wide variety of applications ranging from solar cells to high speed very large scale integrated circuits. The importance of a given material property depends upon device type, circuit design and application. For example, minority carrier lifetime control is very important in junction devices that depend upon minority carrier charge transport (e.g., solar cells and bipolar transistors), whereas the majority carrier concentration is a primary consideration for junction field effect transistors (JFETS) and metal-oxide-semiconductor transistors (MOSFETS). Carrier mobility is important in device performance, but it is less variable than carrier lifetimes and concentrations. Charge particle detector applications which exploit charge generation and separation within Si require careful attention to carrier concentration profiles, and are especially demanding upon control of minority carrier lifetime. DOE

N88-23660# Nebraska Univ., Lincoln.
MAGNETIC STUDIES OF IRON-RARE-EARTH-METALLOID ALLOYS Annual Technical Progress Report
1988 6 p
(Contract DE-FG02-86ER-45262)
(DE88-006801; DOE/ER-45262/2) Avail: NTIS HC A02/MF A01

The theme of our research is the synthesis of study of new iron-rare earth phases which may have significant technological properties. New synthetic methods such as sputtering and new microstructures are sought in an attempt to control important properties such as coercivity, anisotropy (magnitude and direction) in thin films, and spontaneous magnetization. Our aim is to understand these relatively complex materials on the basis of fundamental electronic structure, theories of itinerant magnetism, and the microstructural effects which control the extrinsic properties. DOE

N88-23661# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
A SUP 57 Fe MOSSBAUER STUDY OF THE SUPERCONDUCTOR YBa SUB 2 (Fe SUB x Cu SUB 1-x) SUB 3 O SUB y
E. M. B. Saitovitch, I. S. Azevedo, R. B. Scorzelli, H. Saitovitch, S. F. da Cunha, A. P. Guimaraes, P. R. Silva, and A. Y. Takeushi 1987 24 p
(DE88-701543; CBPF-NF-045/87) Avail: NTIS (US Sales Only) HC A03/MF A01

Fe-57 Mossbauer Spectroscopy measurements were made on the YBa2(Fe sub x Cu sub 1-x) sub 3 O sub y superconducting compounds, for the Fe concentrations of 0.1, 0.5, 3.0 and 10 percent. The Mossbauer spectra, obtained at room temperature and at 4.2 K, are dependent on concentration and show several doublets that can be related to different Cu sites, to the number of oxygen vacancies, and to the presence of a high temperature tetragonal phase. This analysis is based on the values of the quadrupole interactions and on the ratio of the absorption areas. Two Mossbauer doublets in the dilute samples (up to 1.0 percent Fe) are associated to Fe-57 in the Cu sub 1 site of the compound. The 4.2 K spectra of the more concentrated samples (3.0 and 10 percent Fe) show spin relaxation effects indicating that iron has a magnetic moment. Magnetic susceptibility measurements show, with increasing iron concentration, a decrease in chemically bond at 77 K and in increasing iron chemically bond sup dXg sub d T near Tc. DOE

N88-23662# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoj Ehnergii.
MEASUREMENT OF TIME EVOLUTION OF PLASMA ELECTRON COMPONENT PARAMETERS ON THE OGRA-4 DEVICE BY THE THOMSON SCATTERING METHOD
Yu. A. Tarabrin 1987 17 p In RUSSIAN
(DE88-701575; IAE-4441/7) Avail: NTIS (US Sales Only) HC A03/MF A01

Measurements of time evolution of electron distribution function in the Ogra-4 device are described. Measurements were conducted with the use of laser diagnostics complex, operating in pulse-periodic conditions. Time evolution of plasma electron component density and energy distribution of electrons was measured. The presence of intense oscillations of plasma density during the Ogra-4 device operation without injection of neutrals is shown. Accumulation of two groups of cold electrons with energies of tens and hundreds of electron-volt takes place in the center of the trap after injection initiation. It is expained consistently by formation of the positive potential during accumulation of hot ions, confined by magnetic field. Thus, Thomson scattering measurement provided data on accumulation of hot ion component. DOE

N88-23663# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
EFFECTS OF IRRADIATION ON THERMAL COALESCENCE OF PORES IN REAL CRYSTALS
V. I. Dubinko, P. N. Ostapchuk, and V. V. Slezov 1987 11 p In RUSSIAN
(DE88-701683; KFTI-87-23) Avail: NTIS (US Sales Only) HC A03/MF A01

The thermal coalescence of pores in crystals under irradiation with the general theory on the evolution of the dislocation structure, described in terms of the phenomenological mode, is studied. A new thermal coalescence mode, the recombination mode, is found. From comparison with the experiment it is stated that thermal coalescence is responsible for the decrease of pore density with temperature growth, which in the recombination mode proceeds without change of the swelling rate. DOE

N88-23664# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
ELECTROTHERMAL INSTABILITY IN SUPERCONDUCTING RESONATORS
A. N. Belokhvostukov, N. S. Repalov, and N. A. Khizhnyak 1987 5 p In RUSSIAN
(DE88-701684; KFTI-87-30) Avail: NTIS (US Sales Only) HC A02/MF A01

A combined solution of the electrodynamics and heat transfer equations has been performed in the task of excitation of strong electromagnetic oscillations in a superconducting resonator. The effect of heat transfer intensity on the resonator resonance characteristics has been investigated. It is shown that electrothermal instability accompanied with pulsations of resonator wall temperature and electromagnetic field power level takes place in the superconductivity region. Resonator excitation stability criteria have been obtained, as well as the requirements for the cryostatting system. DOE

N88-23665# Utah Univ., Salt Lake City. Dept. of Physics.
FLUXONS AND ORDER IN LONG JOSEPHSON JUNCTIONS Annual Report, 15 Nov. 1986 - 15 Nov. 1987
Orest G. Symko 28 Dec. 1987 27 p
(Grant AF-AFOSR-0020-86)
(AD-A190879; AFOSR-88-0171TR) Avail: NTIS HC A03/MF A01 CSCL 20J

This report presents the research that was conducted in the year 1987 and some of the results achieved. Low frequency fluctuations were studied at metastable states of long Josephson junctions biased at Fiske steps in a magnetic field. The fluctuations exhibit telegraph type of noise whose origin is the thermal noise

of the internal resistance of the junction. Temperature dependence of these fluctuations shows that a thermal activation process is responsible for the behavior. At lower temperatures, quantum mechanical tunneling is expected to contribute to the fluctuations and experiments which are presently being prepared for such studies down to 10 mK in a 3 He to 4 He dilution refrigerator. The one to five curves for our junctions show a regular step structure due to cavity resonances and they also show subharmonic generation of period three due to the strong non-linearities of the dissipative system. Such subharmonic voltage steps are important because they normally precede chaotic behavior. A study was also made of the effects of geometry on fluxon motion and the results show that the device characteristics depend strongly on the bias current distribution in the junction. Studies for the next period are presented. GRA

N88-23666# Stanford Univ., Calif. Electronics Lab.
LIMITED REACTION PROCESSING FOR SEMICONDUCTOR DEVICE FABRICATION Final Report, 30 Sep. 1985 - 30 Nov. 1987
James F. Gibbons Dec. 1987 91 p
(Contract DAAG29-85-K-0237)
(AD-A190913; ARO-23222.17-EL-A) Avail: NTIS HC A05/MF A01 CSCL 09A

A new class of semiconductor processing equipment is shown to be feasible. Test equipment was designed and fabricated which uses a combination of Rapid Thermal and Chemical Vapor Deposition (CVD) technologies to achieve epitaxial growth and deposition of semiconductors and insulators. The trend towards single wafer processing makes Limited Reaction Processing (LRP) particularly relevant to state of the art device fabrication research. GRA

N88-23667# Naval Postgraduate School, Monterey, Calif.
INTERFACE CHARACTERIZATION OF Cu-Cu AND Cu-Ag-Cu LOW TEMPERATURE SOLID STATE BONDS M.S. Thesis
Robert Z. Dalbey Dec. 1987 53 p
(AD-A191015) Avail: NTIS HC A04/MF A01 CSCL 11F

In this study, Auger Electron Spectroscopy (AES), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray (EDX) analysis were used to characterize the interface regions of copper to silver and copper to copper bond samples in an effort to identify those parameters which most affect the bond characteristics. Longitudinal and transverse cross sections of the bond joint are examined. Auger electron sputter depth profiling was used to examine the interface properties and composition across the bond interface. Depth profiles indicate carbon and oxygen diffuse away from the interface during bonding, facilitating adhesion. Tensile tests on bonded samples indicate that bond pressure has a more significant effect on bond strength than temperature. A temperature threshold for bonding is observed which is related to the ability of the bond materials to scavenge their oxides. GRA

N88-23668# Minnesota Univ., Saint Paul.
MICROSCOPIC CONTROL OF SEMICONDUCTOR INTERFACE REACTIVITY Interim Report, 1 Aug. 1986 - 30 Sep. 1987
A. Franciosi 1 Jan. 1988 13 p
(Contract N00014-84-K-0545)
(AD-A191193) Avail: NTIS HC A03/MF A01 CSCL 20L

The goal of our program is to control semiconductor surface and interface behavior by means of local modifications of the surface/interface chemical environment. Major thrust areas include the use of ultrathin semiconductor surfaces, the search for passivating layers to reduce metallization corrosion, and the exploitation of diffusion barrier effects to control interdiffusion at metal-semiconductor junctions. Such studies have potential implications for low temperature synthesis of gate and field oxides, and for enhancing metallization stability against corrosion and electromigration. GRA

N88-23669# Naval Postgraduate School, Monterey, Calif.
EFFECTS OF 67.5 MeV ELECTRON IRRADIATION ON Y-Ba-Cu-O AND Gd-Ba-Cu-O HIGH-TEMPERATURE SUPERCONDUCTORS M.S. Thesis
Eric L. Sweigard Dec. 1987 84 p
(AD-A191271) Avail: NTIS HC A05/MF A01 CSCL 20C

High-temperature superconductors (YBa2Cu3O6+delta and GdBa2Cu3O6+delta, both with delta less than or equal to 1) with Tc approx. 92K and manufactured at the University of Houston were irradiated with 67.5 MeV electrons at fluences of 10 to the 13th, 10 to the 14th, 10 to the 15th and 5 x 10 to the 15th electrons/sq. cm. The irradiation effects were studied by analyzing resistance versus temperature curves developed using the four-probe resistance measuring technique. The YBaCuO sample showed irradiation (.3 Mrad) and an isolated failure to achieve total superconductivity above 77K after the 10 to the 14th irradiation (3 Mrad). The same sample re-established its high-Tc (92K) after subsequent irradiations. This was presumed to indicate microscopic damage to superconducting channels. It also displayed granular crumbling in the vicinity of the electrical contacts. This was interpreted as an effect of the differences in thermal expansion rates between the contacts and the superconductor. GRA

N88-23670# Wales Univ. Inst. of Science and Technology, Cardiff. Dept. of Physics, Electronics and Electrical Engineering.
OPTIMISATION OF THE THERMOELECTRIC FIGURE OF MERIT OF MODIFIED SILICON GERMANIUM ALLOYS Interim Report No. 1
D. M. Rowe Oct. 1987 3 p
(Contract DAJA45-87-C-0048)
(AD-A191347) Avail: NTIS HC A02/MF A01 CSCL 09A

Alloys of silicon and germanium are established semiconductor materials for use in high temperature thermoelectric conversion systems. The conversion efficiency of a thermoelectric device depends, among other things, upon the material properties of the thermoelements through the so-called figure of merit Z = (alpha squared) sigma/lambda where alpha is the Seebeck coefficient, Sigma the electrical conductivity and Lambda the total thermal conductivity. It has been predicted and demonstrated experimentally that the lattice thermal conductivity Lambda sub L of semiconductor alloys can be substantially reduced through the use of very small grain size compacted material. GRA

N88-23671# Cambridge Univ. (England).
MBE OF HgCdTe Interim Report
T. D. Golding 1987 5 p
(Contract DAJA45-87-C-0033)
(AD-A191423; IR-1) Avail: NTIS HC A02/MF A01 CSCL 20L

A feasibility study of Indium antimonide/Cadmium telluride superlattices and InSb/CdTe/InSb barrier systems for study of vertical transport properties has been conducted. Auger depth profiles of four-period InSb/CdTe (200/200A) SL grown at 300, 200, and 75 C indicate severe interdiffusion and/or growth problems with this system. CdTe can be successfully grown within the temperature range 180 to 300 C. InSb is typically grown between 300 to 400 C. Thus at present the overlap in the InSb and CdTe growth temperature windows is around 300 C. It is also apparent that there is very little incorporation of cadmium. This is believed to be a consequence of the growth mechanism during the growth of an InSb/CdTe SL whereby the Tellurium bonds with In resulting in Cd deficient layers. Once the available indium has bonded with the tellurium stoichiometric CdTe will then prevail. It is apparent that in order to obtain abrupt InSb/CdTe heterojunctions a full study of the parameters during growth will have to be made. GRA

N88-22992 Joint Publications Research Service, Arlington, Va.
NEW METHOD OF GRAFTING CRYSTALS
N. Krivenko *In its* JPRS Report: Science and Technology. USSR: Materials Science 17 Mar. 1988 p 20-22 Transl. into ENGLISH from Tekhnika i Nauka (Moscow, USSR), no. 5, May 1987 p 16-17 (For primary document see N88-22988 16-27)
Copyright Avail: Issuing Activity

N88-23023# Joint Publications Research Service, Arlington, Va.
HIGH-SPEED ELECTRON BEAM LITHOGRAPHY DEVICES DISCUSSED
Yuuta Sagara *In its* JPRS Report: Science and Technology. Japan 11 Sep. 1987 p 44-46 Transl. into ENGLISH from Toshi Keizai (Tokyo, Japan), Sep. 1986 p 40-41 (For primary document see N88-23018 16-31)
Avail: NTIS HC A05/MF A01

N88-23488# Kyushu Univ., Fukuoka (Japan).
ELECTRICAL ANISOTROPY OF LAYERED SEMICONDUCTOR ZrSe2
Xu-guang Zheng, Hisao Kuriyaki, and Kazuyoshi Hirakawa *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 135-139 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-23672# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
COMPUTATIONAL QUANTUM FIELD THEORY
N. V. Makhaldiani 1986 14 p In RUSSIAN; ENGLISH summary
(DE88-700918; JINR-R-2-86-849) Avail: NTIS (US Sales Only) HC A03/MF A01

The computational quantum field theory (CQFT) is considered as part of computational physics. The main mathematical structures of the CQFT are described in the case of quantum chromodynamics. As examples of the application of the CQFT methods, the calculation of the topological susceptibility and the gluon condensates are considered. DOE

N88-23673# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
RELATIVISTIC THEORY OF GRAVITATION AND CRITICISM OF GENERAL RELATIVITY THEORY (GRT)
A. A. Logunov, Yu. M. Loskutov, and M. A. Mestvirishvili 1987 41 p
(DE88-701304; IFVE-OTF-87-38) Avail: NTIS (US Sales Only) HC A03/MF A01

This paper discusses two subjects: (1) inacceptability of General Relativity Theory (GRT) as a physical theory of gravity, and (2) construction of the Relativistic Theory of Gravitation (RTG) possessing all the attributes of field theories. DOE

N88-23674# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
SPECIAL RELATIVITY THEORY (ONE-DIMENSIONAL CASE) WITHOUT THE POSTULATE ON THE EQUALITY OF DIRECTIONS
V. N. Lyakhovitskij 1987 12 p In RUSSIAN
(DE88-701368; ITEF-45(1987)) Avail: NTIS (US Sales Only) HC A03/MF A01

The consequences of giving up the postulate on the equality of positive and negative x axis directions are shown and analyzed for one-dimensional motion of inertial systems. The logic foundations of the theory, except the above postulate, coincide with those conventional a lead in particular (in the assumption of equality of positive and negative x axis directions) to the development of standard special relativity theory. The giving up of the above postulate results in the conclusion of the possibility of existence of different maximum velocities a and b, corresponding to motions in positive and negative x axis directions. The relativistic factor and the method of velocity composition, due to dependence on a and b, differ from those conventional, but transfer into them on the assumption of equality of directions along the x axis. DOE

N88-23675# Lawrence Livermore National Lab., Calif.
ELECTRICAL RESISTIVITY AS QUANTUM CHAOS
R. B. Laughlin Aug. 1987 13 p Presented at the International Conference on the Physics of Chaos and Systems Far From Equilibrium, Monterey, Calif., 11 Jan. 1987 Prepared in cooperation with Stanford Univ., Calif.
(Contract W-7405-eng-48)
(DE88-007026; UCRL-98216; CONF-8701113-1) Avail: NTIS HC A03/MF A01

The physics of quantum transport is re-examined as a problem in quantum chaos. It is proposed that the random potential in which electrons in dirty metals move is not random at all, but rather any potential inducing the electron motion to be chaotic. The Liapunov characteristic exponent of classical electron motion in this potential is identified with the collision rate I/tau appearing in Ohm's law. A field theory for chaotic systems, analogous to that used to describe dirty metals, is developed and used to investigate the quantum Sinai billiard problem. It is shown that a noninteracting degenerate electron gas moving in this potential exhibits Drude conductivity. DOE

N88-23676# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
HYPERELLIPTIC STATSUMS IN SUPERSTRING THEORY
A. Morozov 1987 7 p
(DE88-701646; ITEP-69(1987)) Avail: NTIS (US Sales Only) HC A02/MF A01

The expression for the holomorphic measure on the module space of hyperelliptic Riemann surfaces, which possess modular properties required for the statistical sum of the superstring, is proposed. DOE

N88-23677# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
ON THE HILBERT SPACE OF SUPERSYMMETRIC QUANTUM SYSTEMS
M. A. Shifman, A. V. Smilga, and A. I. Vajnshtein 1987 20 p
(DE88-701648; ITEP-109(1987)) Avail: NTIS (US Sales Only) HC A03/MF A01

It is shown that in some quantum-mechanical models the consequences of supersymmetry take place only provided certain additional conditions are imposed on the wave functions. If this fact is not taken into account one may encounter paradoxes. The question of the fermion condensate in the (reduced) sigma model and supersymmetric gauge theories are discussed, in particular. DOE

N88-23678# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INTEGRABILITY OF FERMIONIC STRING IN SUPERFLUID HAMILTONIAN APPROACH
V. I. Borodulin and A. P. Isaev 1987 14 p In RUSSIAN; ENGLISH summary
(DE88-701662; JINR-R-2-87-376) Avail: NTIS (US Sales Only) HC A03/MF A01

The Hamiltonian superfield formalism of fermionic string (FS) theory is introduced and is used for finding a general solution to the Hamiltonian equations of motion. An auxiliary spectral problem for FS-theory is investigated and an infinite set of conservation laws is constructed. Also, a method of constructing classical analogues of vertex operators describing the FS-massless field coupling is presented. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

N88-23679*# Alabama A & M Univ., Normal. Dept. of Chemistry.
ELEMENTARY AND MIDDLE SCHOOL SCIENCE IMPROVEMENT PROJECT Final Report, May 1986 - Apr. 1987
Saundra Yancy McGuire Apr. 1987 83 p
(Contract NAS8-36277)
(NASA-CR-179328; NAS 1.26:179328) Avail: NTIS HC A05/MF A01 CSCL 05I

The Alabama A & M University Elementary and Middle School Science Improvement Project (Project SIP) was instituted in response to a need to improve the ability of North Alabama teachers to teach science effectively using the experimental or hands-on approach. The major component of the project was a two-week workshop. Follow-up visits were made to the classrooms of many of the participating teachers to obtain information on how the program was being implemented in the classroom. The administrative aspects of the program, the delivery of the services to participating teachers, and the project outcomes are addressed. Author

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

No abstracts in this category.

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-23680# Army Engineer Studies Center, Fort Belvoir, Va.
THE ENGINEER STUDIES CENTER GUIDE TO RESEARCH AND DATA COLLECTION Final Report, Sep. - Oct. 1987
Richard L. Taylor, Douglas Lehman, and Jill Davis 30 Nov. 1987 31 p
(AD-A189971; USAESC-R-88-2) Avail: NTIS HC A03/MF A01 CSCL 12A

THis paper provides tips and guidelines for use in facilitating better research and data collection when undertaking US Army studies and analysis. It is intended for use by analysts and military planners at the US Army Engineer Studies Center (ESC). However, the tips provided herein are applicable throughout the US Army study analysis community. This report specifically gives background on the ESC study process, focuses on the research phase of the ESC study process, provides ten tips for better research and data collection, and provides several observations on the research collection process. An annex listing selected libraries used often by ESC analysts is also provided. GRA

N88-23681# Syracuse Univ., N. Y.
NEW GENERATION KNOWLEDGE PROCESSING, VOLUME 2 Final Report, Dec. 1983 - Jan. 1987
J. A. Robinson and Kevin J. Greene Oct. 1987 198 p
(Contract F30602-84-K-0001)
(AD-A190166; RADC-TR-87-165-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 12E

The main goal of this project was to design a high-level programming system SUPER (Syracuse University Parallel Expression Reducer) with two parts: a language which would combine the functional (as in LISP, SASL, or ML) with the relational (as in PROLOG) programming concepts into a single new paradigm and a machine which would execute programs written in the language, using reduction and a multiprocessor architecture. The SUPER language is an extension of the basic lambda-calculus which we call lambda plus. It is formally a collection of expressions together with some rules and definitions which give them meaning and make it possible to do deductive reasoning and computation with them. The expressions of the SUPER language fall into three main syntactic categories: atoms, abstractions, and combinations. Volume 2 contains a detailed presentation of the single-processor software programming system LNF which was developed to serve as a test bed and simulation tool for the classical part of the SUPER system. GRA

N88-23682# Syracuse Univ., N. Y.
NEW GENERATION KNOWLEDGE PROCESSING, VOLUME 3 Final Report, Dec. 1983 - Jan. 1987
J. A. Robinson and Kevin J. Greene Oct. 1987 67 p
(Contract F30602-84-K-0001)
(AD-A190167; RADC-TR-87-165-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 12E

The main goal of this project was to design a high-level programming system SUPER (Syracuse University Parallel Expression Reducer) with two parts: a language which would combine the functional (as in LISP, SASL, or ML) with the relational (as in PROLOG) programming concepts into a single new paradigm and a machine which would execute programs written in the language, using reduction and a multiprocessor architecture. The SUPER language is an extension of the basic lambda-calculus which we call lambda plus. It is formally a collection of expressions together with some rules and definitions which give them meaning and make it possible to do deductive reasoning and computation with them. The expressions of the SUPER language fall into three main syntactic categories: atoms, abstractions, and combinations. Volume 1 describes the SUPER system, and discusses the conceptual background in terms of which it can best be understood. Volume 3 presents the final, enhanced version of LNF, which we call LNF-Plus and which provides the user with as close an approximation as we can achieve on a single processor of the SUPER system. as a test bed and simulation tool for the classical part of the SUPER system. Volume 3 presents the final, enhanced version of LNF, which we call LNF-Plus and which provides the user with as close an approximation as we can achieve on a single processor of the SUPER system. GRA

N88-23683# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Hubschrauber und Flugzeuge.
DATA BASE MANAGEMENT IN CAD/CAM SYSTEMS: REQUIREMENTS FOR CAD/CAM DATA BASES, ACTUAL MARKET OFFER, ADVICE FOR AN EFFICIENT DATA BASE MANAGEMENT, DEVELOPMENT TENDENCIES [DATANBANK-MANAGEMENT IN CAD/CAM-SYSTEMEN: ANFORDERUNGEN AN CAD/CAM-DATANBANKEN - DERZEITIGES MARKTANGEBOT - EMPFEHLUNGEN FUER EFFIZIENTES DB-MANAGEMENT - ENTWICKLUNGSTENDENZEN]
Werner Fischer Jul. 1986 36 p In GERMAN
(MBB/LWD-11/S/PUB/254; ETN-88-91443) Copyright Avail: NTIS HC A03/MF A01

Requirements, status, objectives, and trends of data base management in CAD/CAM systems are treated. The requirements of Computer-Integrated-Manufacturing (CIM)-oriented information processing are discussed. Presently used data-processing supported CAD/CAM scenarios are reviewed. Hardware and software objectives in information processing are presented. The evolution in CAD/CAM systems from single solutions towards universally applicable data base systems is depicted. ESA

N88-23684# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
DATA MANAGEMENT STRATEGIES IN THE INDUSTRIAL ENVIRONMENT
R. P. deMoel and F. J. Heerema 8 Jan. 1987 24 p In DUTCH; ENGLISH summary Presented at CAPE Nederland '87, Amsterdam, The Netherlands, 17-19 Mar. 1987
(NLR-MP-87002-U; B8731727; ETN-88-92227) Avail: NTIS HC A03/MF A01

Use of data management technology by industry is discussed. Working methods, responsibilities and habits, confidence in automation, and panic related to own status are considered. ESA

N88-23685# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
A LIKELIHOOD BASED GROUPING METHOD FOR MULTIDIMENSIONAL OBSERVATIONS. AN INTERACTIVE METHOD USED ON LARGE TRANSPORTATION DATA BASES
Rudi Hamerslag and Wim H. Scheltes (Netherlands Inst. of Transport, Rijswijk.) 1987 22 p
(Rept-87-74; B8735609; ISSN-0920-8577; ETN-88-92450)
Copyright Avail: NTIS HC A03/MF A01

A method for data clustering that results in homogeneous subordinate data populations is discussed. It uses Fisher's likelihood theory to define the distances between groups of data. Its dissimilarity measure therefore depends on the probability density function of observations. Three different dissimilarities, each based on different data distributions and each consistent with the likelihood theory, are treated. Advantages of the method include detection of dependencies between variables; curtailment of cluster and segmentation techniques; and each probability function has its own optimal (dis)similarity measure, derived using the likelihood theory. The method conserves all the advantages of hierarchical divisive techniques, which makes it suitable for analysis of large surveys. It was developed for transportation science, but is suitable for other research involving large data sets. ESA

N88-23686# Naval Ocean Systems Center, San Diego, Calif. Special Libraries Association.
TRANSLATIONS OF SCIENTIFIC AND TECHNICAL LITERATURE: A GUIDE TO THEIR LOCATION
Kathleen Wright [1987] 32 p
Avail: NTIS HC A03/MF A01

The purpose of this guide is to assist searchers in the location of English language translations of foreign scientific and technical literature. Strategies for locating an existing translation are given along with guidance for users who do not have access to the major bibliographic tools. Major providers of existing translations are described, and procedures for having a publication translated by a commercial firm or a government agency are suggested. Author

N88-23687*# Old Dominion Univ., Norfolk, Va. Dept. of Computer Science.
AUTOMATED DATABASE DESIGN TECHNOLOGY AND TOOLS Final Report, period ending 29 Feb. 1988
Stewart N. T. Shen Jun. 1988 9 p
(Contract NAS1-17993)
(NASA-CR-182875; NAS 1.26:182875) Avail: NTIS HC A02/MF A01 CSCL 05B

The Automated Database Design Technology and Tools research project results are summarized in this final report. Comments on the state of the art in various aspects of database design are provided, and recommendations made for further research for SNAP and NAVMASSO future database applications. Author

N88-23688# Georgia Inst. of Tech., Atlanta. School of Information and Computer Science.
EXTRACTING INFORMATION FROM PROBLEM SOLVING EXPERIENCE Interim Report, Jul. 1986 - Jun. 1987
Janet L. Kolodner Dec. 1987 5 p
(Contract MDA903-86-C-0173; DA Proj. 2Q1-61102-B-74-F)
(AD-A191331; ARI-RN-87-81) Avail: NTIS HC A02/MF A01 CSCL 05H

Much of the problem solving which is performed involves consideration of previous similar situations. Access to previous experience keeps the problem solver from avoiding past mistakes, and aids in the derivation of shortcuts for reasoning. This document outlines the research studying the processes that comprise this problem solving style. Topics outlined include: organization of cases and generalized knowledge in memory, knowledge structures, the evolution of knowledge structures, analogical problem solving, and failure-driven learning. GRA

N88-23489# Kyushu Univ., Fukuoka (Japan).
A TIMESTAMP ORDERING MECHANISM WITH DYNAMIC SELECTION OF ROLLBACK OBJECTS
Xingguo Zhong and Yahiko Kambayashi *In its* Technology Reports of Kyushu University, Volume 61, No. 2 Mar. 1988 p 141-148 In JAPANESE; ENGLISH summary (For primary document see N88-23485 16-64)
Avail: NTIS HC A06/MF A01

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-23689# Committee on Appropriations (U.S. House).
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT INDEPENDENT AGENCIES APPROPRIATIONS FOR 1989. PART 7: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington GPO 1988 1137 p Hearings before a subcommittee of the Committee on Appropriations, 100th Congress, 2d Session, 19 Apr. 1988, part 7
(GPO-85-166) Avail: Committee on Appropriations, House of Representatives, Washington, D.C. 20515 HC free

Hearings before a subcommittee of the House Committee on Appropriations are presented along with the budget estimates for the National Aeronautics and Space Administration for the fiscal year 1989. All written testimony and submittals for the record are also included. The budget estimates provide a detailed outline of budgetary information and justifications for research and development, construction of facilities, space flight and communications, and research and program management. M.G.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-23690# Technische Hogeschool, Delft (Netherlands). Faculty of Mathematics and Informatics/Computer Science.
A THREE DIMENSIONAL ASSIGNMENT METHOD IN THE TIME SPACE
R. Hamerslag and P. C. H. Opstal 1987 25 p In DUTCH; ENGLISH summary
(Rept-87-49; B8731208; ISSN-0920-2358; ETN-88-91858)
Copyright Avail: NTIS HC A03/MF A01

Vehicle routing to avoid bottlenecks is discussed. An assignment algorithm which uses space as a third dimension is presented. It helps overcome problems with models which assign vehicles to the whole route. ESA

N88-23691# Lea (N. D.) and Associates, Inc., Chantilly, Va.
COSTS AND BENEFITS OF AC PROPULSION
K. Berger Jul. 1987 96 p
(Contract DTUM60-82-C-71122)
(PB88-173380; UMTA-IT-06-0273-87-1) Avail: NTIS HC A05/MF A01 CSCL 13F

The ac inverter propulsion offers substantial savings in operating and maintenance costs through elimination of moving parts. The fundamental principle of ac propulsion is described and the sources of the improved reliability and cost savings illustrated. An Appendix to the report presents a cost and reliability data base and life cycle cost analysis for the cam controlled dc propulsion system of the New York City Transit Authority R44 cars. It was prepared as a standard of comparison for the evaluation of ac inverter propulsion systems developed under the UMTA Subsystem Technology Applications to Rail Systems (STARS) program, and was used for the cost comparisons. Also in the appendix, the life cycle cost of the R44 car propulsion system is evaluated with a simple present-worth technique. GRA

N88-23692# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
APPLICATIONS OF MULTITEMPORAL COMPOSITIONS OBTAINED FROM LANDSAT DATA IN THE STUDY OF URBAN GROWTH [APLICACOES DE COMPOSICOES MULTITEMPORAIS OBTIDAS A PARTIR DE DADOS LANDSAT NO ESTUDO DE CRESCIMENTO URBANO]
Madalena NieroPereira, Maria deLourdesNevesdeO.Kurkdjian, Celina Foresti, and Ubirajara Mauricio BarsottideLima Mar. 1988 19 p In PORTUGUESE; ENGLISH summary Presented at the 3rd Brazilian Symposium on Remote Sensing, Rio de Janeiro, Brazil, 1984
(INPE-4480-PRE/1246) Avail: NTIS HC A03/MF A01

Urban growth has developed in an accelerated and disorganized manner in most Brazilian cities. One of the factors influencing the monitoring and control of urban growth is the lack of precise and updated information. Through the use of satellite remote sensing it is possible to obtain a repetitive covering of the target area showing the different tendencies of urban growth. Thus, the objective of this study is to analyze urban growth in the city of Sao Jose dos Campos during the past six years, using automatic digital processing of LANDSAT data. The algorithm Image Registration was used as implemented on the Image-100 System, which correlates image registration of LANDSAT data for different dates. Multitemporal color compositions using colored filters (blue, green, and red) were obtained. The analysis of the composites permitted the evaluation of the urban growth of Sao Jose dos Campos and showed the intense process of construction in isolated residential areas resulting from the redistribution of rural land into parcels or lots. Author

N88-23693# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UPDATING LAND-USE OF THE SAO JOSE DOS CAMPOS MUNICIPALITY THROUGH REMOTE SENSING DATA [ATUALIZACAO DO USO DA TERRA DO MUNICIPIO DE SAO JOSE DOS CAMPOS ATRAVES DE DADOS DE SENSORIAMENTO REMOTO]
Madalena NieroPereira, Evlyn Marcia LeaodeMoraesNovo, Maria deLourdesN.deO.Kurkdjian, Julio Cesar LimaDAlge, and Teresa GallottiFlorenzano Mar. 1988 66 p In PORTUGUESE; ENGLISH summary
(INPE-4479-RPE/562) Avail: NTIS HC A04/MF A01

The land-use survey of Sao Jose dos Campos municipality using black and white aerial photographs is related to LANDSAT TM imagery. This work was carried out in a joint-cooperation with the local municipal administration according to the agreement that INPE provides the technical support to the local agency. The project included: (1) the developing of data interpretation methodology for LANDSAT-TM data and aerial photographs; (2) the evaluation of TM imagery for land-use mapping and monitoring; (3) the technology transfer of the developed methodology to the local agency through training courses; and (4) technical advice on the process of mapping the whole municipality using aerial photographs on the scale of 1:25,000. Land use maps on the scales of 1:25,000 and 1:100,000 based on aerial photographs and LANDSAT-TM imagery were produced. The mapping accuracy of the land use map obtained by using the LANDSAT-TM imagery is 85 percent at the 95 percent confidence level. The results demonstrate the adequacy of TM data for land-use mapping. Author

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-23694# Kyoto Univ. (Japan).
MEMOIRS OF THE FACULTY OF SCIENCE, KYOTO UNIVERSITY. SERIES OF PHYSICS, ASTROPHYSICS, GEOPHYSICS AND CHEMISTRY, VOLUME 37, NO. 2
Mar. 1988 229 p
(ISSN-0368-9689) Avail: NTIS HC A11/MF A01

Topics addressed include: pseudoscalar meson production; digital surface photometry; photographic observations of Halley's comet; production of high mass dielectrons; inelastic scattering of polarized protons; measurement of Sigma sup + polarization parameters; photographic observations of the HII region S296; dust and C2 contents in the coma of Halley's comet; and gamma-vibrations in deformed nuclei. For individual titles, see N88-23695 through N88-23698.

N88-23695# Kyoto Univ. (Japan). Dept. of Astronomy.
METHOD OF DIGITAL SURFACE PHOTOMETRY OF GALAXIES AND ITS APPLICATION TO THE EDGE-ON GALAXY NGC 5907
Toshiyuki Sasaki *In its* Memoirs of the Faculty of Science, Kyoto University. Series of Physics, Astrophysics, Geophysics and Chemistry, Volume 37, No. 2 Mar. 1988 p 139-180 (For primary document see N88-23694 16-89)
Avail: NTIS HC A11/MF A01

A method of digital surface photometry of galaxies was developed to achieve the accurate photometry of the faint outskirt of the galactic disk. The method includes the stack of photographic plates to increase the signal to noise ratio of the data. Performance

test of the measuring instrument Joyce-Loebl MDM6 and the procedures of digital surface photometry are fully described. The procedures are applied to the edge-on Sc galaxy NGC 5907 with a particular intention to reveal optical warping of the outer disk. Seven and eight deeply-exposed photographic plates in blue (J) and red (F) color bands, respectively, are analyzed. The photometric accuracy of 0.04 mag at levels brighter than 24.5 J mag arcsec sup -2 and 0.46 mag at the faintest level is achieved after stacking plates. The photometric data of NGC 5907 are presented in the Vaucouleurs' system in tabular form. Author

N88-23696# Kyoto Univ. (Japan). Dept. of Astronomy.
NARROW-BAND PHOTOGRAPHIC OBSERVATIONS OF THE HII REGION S296 IN CANIS MAJOR
T. Kogure, S. Yoshida, S. D. Wiramihardja, M. Nakano (Oita Univ., Japan), and K. Sakka *In its* Memoirs of the Faculty of Science, Kyoto University. Series of Physics, Astrophysics, Geophysics and Chemistry, Volume 37, No. 2 Mar. 1988 p 181-190 (For primary document see N88-23694 16-89)
Avail: NTIS HC A11/MF A01

The monochromatic images of the HII region S296 taken with the UK Schmidt telescope at the emission lines H alpha + (NII), (SII), (OIII), and (OII) are presented, together with some composite images. Based on these photographic images, the overall ionization structure of the HII region is briefly considered. Author

N88-23697# Kyoto Univ. (Japan).
DUST AND C2-CONTENTS IN THE COMA OF HALLEY'S COMET (1986III) **c90**
Tokuhide Akabane, Yoichiro Hanaoka, Kyosuke Iwasaki, Shingo Kawakami, Yoshihiro Nakai, Sumisaburo Saito, and Akitsugu Takeuchi *In its* Memoirs of the Faculty of Science, Kyoto University. Series of Physics, Astrophysics, Geophysics and Chemistry, Volume 37, No. 2 Mar. 1988 p 283-290 (For primary document see N88-23694 16-89)
Avail: NTIS HC A11/MF A01

Photographic observations of Halley's Comet (1968III) were carried out at the Hida Observatory, with the use of two interference filters: IF7215 (for the red continuum at 7215 A) and IF5148 (for C2 emission at 5148 A). The negatives exposed on March 25, 31, April 1, 12, and 13, 1986 were analyzed and the total mass of dust and C2 molecules of the coma were estimated. On March 25 masses of dust and C2 were 3.3 x 10 to the 13th g and 2.2 x 10 to the 10th g respectively. Dust and C2-contents fall off as the comet goes away from the Sun, and become reduced to 5.1 x 10 to the 12th g and 1.3 x 10 to the 9th g, respectively, on April 13, 1986. Author

N88-23698# Kyoto Univ. (Japan). Dept. of Astronomy.
PHOTOGRAPHIC OBSERVATIONS OF THE LARGE SCALE FEATURES OF COMET HALLEY **c90**
T. Tsujimura, J. Kubota, Y. Hanaoka, S. Kawakami, and T. Kogure *In its* Memoirs of the Faculty of Science, Kyoto University. Series of Physics, Astrophysics, Geophysics and Chemistry, Volume 37, No. 2 Mar. 1988 p 291-301 (For primary document see N88-23694 16-89)
Avail: NTIS HC A11/MF A01

Thirteen representative pictures of Comet Halley which were taken during its 1985/1986 apparition are presented. Some discussions of peculiar features seen in the tail are given. Author

N88-23699 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
TELESCOPE ILLUMINATION AND BEAM MEASUREMENTS FOR SUBMILLIMETER ASTRONOMY
A. I. Harris Apr. 1987 24 p Submitted for publication (MPE-Preprint-88; ETN-88-92085) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

In order to determine the effects of changing edge taper, idealized aperture and beam efficiencies for telescopes which are used for submillimeter astronomical observations were calculated. The optimum illumination edge taper is near 10 dB for large infrared telescopes, and is not very critical as long as it is between 10 and 13 dB. A method for accurately measuring beam sizes on sources which have sizes comparable with the beam is presented. ESA

N88-23700 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THE GALACTIC NUCLEUS AT mm-, SUB-mm AND FAR-INFRARED WAVELENGTHS
R. Genzel Nov. 1987 42 p Submitted for publication (MPE-Preprint-102; ETN-88-92087) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The impact of measurements in the 10 micron to 1 cm wavelength region on knowledge about the nucleus of our galaxy (the central few hundred parsecs) is discussed. Determination of energetics, physical conditions, and dynamics in the nucleus through spectroscopic observations of interstellar matter is emphasized. Phenomena found in the galactic nucleus are reviewed. The basic interpretation of line radiation is considered. Observations of interstellar clouds at scales of several hundred parsecs, of the giant cloud and star formation region Sgr B2, and of the galactic center (Sgr A) itself are treated. ESA

N88-23701* Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
SUBMILLIMETER AND FAR INFRARED LINE OBSERVATIONS OF M17 SW: A CLUMPY MOLECULAR CLOUD PENETRATED BY UV RADIATION
J. Stutzki, G. J. Stacey, R. Genzel, A. I. Harris, D. T. Jaffe, and J. B. Lugten (California Univ., Berkeley.) Nov. 1987 69 p Submitted for publication Sponsored in part by Rockwell International, Pittsburgh, Pa.
(Grants NAG2-208; NSF AST-83-51381)
(NASA-CR-182866; NAS 1.26:182866; MPE-Preprint-103; ETN-88-92088) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

Millimeter, submillimeter, and far infrared spectroscopic observations of the M17 SW star formation region are discussed. The results require the molecular cloud near the interface to be clumpy or filamentary. As a consequence, far ultraviolet radiation from the central OB stellar cluster can penetrate into the dense molecular cloud to a depth of several pc, thus creating bright and extended (CII) emission from the photodissociated surfaces of dense atomic and molecular clumps or sheets. The extended (CII) emission throughout the molecular cloud SW of the M17 complex has a level 20 times higher than expected from a single molecular cloud interface exposed to an ultraviolet radiation field typical of the solar neighborhood. This suggests that the molecular cloud as a whole is penetrated by ultraviolet radiation and has a clumpy or filamentary structure. The number of B stars expected to be embedded in the M17 molecular cloud probably can provide the UV radiation necessary for the extended (CII) emission. Alternatively, the UV radiation could be external, if the interstellar radiation in the vicinity of M17 is higher than in the solar neighborhood. ESA

N88-23702 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THE DISTANCE TO THE CENTER OF THE GALAXY: H2O MASER PROPER MOTIONS IN Sgr B2(N)
M. J. Reid, M. H. Schneps, J. M. Moran, C. R. Gwinn, R. Genzel, D. Downes, and B. Roennaeng (Onsala Space Observatory, Sweden) Nov. 1987 21 p Submitted for publication (MPE-Preprint-104; ETN-88-92089) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The proper motions of H2O maser spots associated with the star forming region Sgr B2(N), which lies close to the galactic center were measured via 5 VLBI observations spanning 1.5 yr. Relative positional accuracies are 20 micro as across a 4 arcsec

field, yielding relative transverse velocities with uncertainties of a few km/sec. The proper motion information shows that the dominant motions of the Sgr B2(N) masers are expansion, with evidence for rotation. The source is modeled as an expanding (and rotating) flow. Parameters including the source distance, the expansion center, and the expansion and rotation velocities were estimated by fitting the kinematic data in a least-squares sense. The expansion velocity is 45 km/sec suggesting that the outflow in Sgr B2(N) is more energetic than the outflow associated with IRc 2 in Orion. The rotation velocity at a radial distance of 1 arcsec is 20 km/sec, indicating a mass enclosed by the 2 arcsec masing region of 20,000 solar mass. The distance tc the Sgr B2(N) H2O masers, and hence the distance to the galactic center is 7.1 kpc with a 1 standard-deviation uncertainty, including systematic sources of error, of 1.5 kpc. ESA

N88-23703# Ministerie van Onderwijs en Wetenschappen, s'Gravenhage (Netherlands).
ADVICE FOR ASTRONOMICAL RESEARCH [ADVIES INZAKE HET ASTRONOMISCH ONDERZOEK]
Nov. 1986 21 p In DUTCH
(ISBN-9-03-460977-4; ETN-88-91608) Avail: NTIS HC A03/MF A01; Raad van Advies voor het Wetenschapsbeleid, T.N.V., Distributiecentrum Overheidspublikaties DOP, Postbus 20014, 2500 EA's-Gravenhage, The Netherlands 7.50 DF

The scientific, social, and financial prospects of Dutch astronomical research from the Earth are outlined. The position of astronomy in scientific research in the Netherlands is depicted. Results in astronomy are compared with those of other countries and with those of related disciplines in the Netherlands. The scientific efficiency of astronomical research and education are evaluated. ESA

N88-23704 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THE X-RAY PROPERTIES OF AM HER STARS
K. Beuermann Nov. 1987 28 p Submitted for publication
(MPE-Preprint-106; ETN-88-92342) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The X-ray observations with EINSTEIN, HEAO-1, and EXOSAT of AM Her binaries are discussed. The presence of a soft X-ray excess is established. Two-pole emission is observed in several systems. The near pole (as seen from the secondary) always emits X-rays when the system is active. The far pole emits only weak cyclotron radiation in some systems, but may become the dominant soft X-ray pole in others. The parameter which most directly determines the dominant energy loss mechanism is the specific accretion rate. The total accretion rate and its time structure may also play an important role. The plasma-physical processes in the magnetosphere which determine the density and ionization structure of the accretion stream are not well understood, such as what causes, e.g., the stream to subdivide into flows toward both poles of which one may be cyclotron dominated and the other soft X-ray dominated. More theoretical work is needed to better understand the interaction of the accretion stream with the magnetosphere and the plasma physics and radiative transfer in the accretion region on the white dwarf. ESA

N88-23705 Max-Planck-Inst. fuer Physik und Astrophysik, Garching (West Germany). Inst. fuer Extraterrestrische Physik.
THE THERMAL EVOLUTION OF THE JETS IN SS433
W. Brinkmann, H. H. Fink, S. Massaglia, G. Bodo (Osservatorio Astronomico, Turin, Italy), and A. Ferrari Dec. 1987 36 p Submitted for publication
(MPE-Preprint-107; ETN-88-92343) Copyright Avail: Fachinformationszentrum Karlsruhe, 7514 Eggenstein-Leopoldshafen 2, Fed. Republic of Germany

The two oppositely precessing jets of galactic object SS443 are discussed. Measurements of SS433 with the EXOSAT satellite indicate that the bases of the jets consist of thermally radiating matter at X-ray temperatures. A detailed numerical treatment shows how the expected thermal instability in the cooling flow evolves, leading to a clumpy medium as deduced from optical observations. The X-ray spectral and luminosity constraints allow a much better understanding of the evolution and energetics of the jets and it is argued that the required reheating of the cold blobs may be achieved by dissipation of a minute fraction of the jet's kinetic energy. ESA

N88-23706# Leiden Univ. (Netherlands).
A SPECTROSCOPIC STUDY OF ABSORPTION AND EMISSION FEATURES OF INTERSTELLAR DUST COMPONENTS Ph.D. Thesis
Gerardus Petrus vanderZwet 1986 159 p Sponsored by the Netherlands Organization for the Advancement of Pure Research
(B8681462; ETN-88-92475) Avail: NTIS HC A08/MF A01

Molecular orgin of the 217.5 nm interstellar hump; visible and infrared spectroscopy of dirty ices and organic residues; polycyclic aromatic hydrocarbons and the diffuse interstellar bands; experimental determination of an upper limit for the ultraviolet pumped infrared emission efficiency of formaldehyde in low temperature matrices and of organic residues; the infrared spectrum of formaldehyde in molecular matrices and the emission features near 3.5 micron in the premain-sequence star HD97048; and the infrared spectrum of the 1:1 complex of formaldehyde with carbon dioxide in argon and nitrogen matrices are discussed. ESA

N88-23707# Leiden Univ. (Netherlands).
THERMAL-NONTHERMAL RELATIONSHIPS IN ACTIVE GALACTIC NUCLEI Ph.D. Thesis
Gerrit Jan deWaard 1986 221 p Sponsored by the Netherlands Foundation for Astronomical Research
(B8681482; ETN-88-92476) Avail: NTIS HC A10/MF A01

Active galactic nuclei on the scale of kpc; extended radio emission around kpc-scale radio cores; a search for HI and OH absorption in high redshifted quasars; a 1.4 GHz VLBI survey of active galactic nuclei having narrow emission line profiles; active galactic nuclei on the scale of pc; a 5 GHz VLBI survey of active galactic nuclei having broad emission line profiles; optical FeII emission and the broad line region in active galactic nuclei; kinematic screen models for superluminal expansion of radio sources; and radio VLBI observations and optical spectroscopy of active galaxies with compact radio and strong optical FeII emission are discussed. ESA

N88-23708# Leiden Univ. (Netherlands).
STARS, GAS AND DUST IN THE ANDROMEDA GALAXY Ph.D. Thesis
Reinirus Antonius Ma Walterbos 1986 205 p Sponsored by the Netherlands Foundation for Astronomical Research
(B8679680; ETN-88-92477) Avail: NTIS HC A10/MF A01

High resolution radio continuum observations of Messier 31 at 1412 MHz; multicolor photographic surface photometry of the Andromeda galaxy; radio continuum emission from the nuclear region of M31: evidence for a nuclear radio spiral; an optical study of stars and dust in the Andromeda galaxy; infrared emission from interstellar dust in the Andromeda galaxy; and a comparison of the Andromeda galaxy and the Milky Way are discussed. ESA

N88-23709# Leiden Univ. (Netherlands).
OPTICAL AND INFRARED OBSERVATIONS OF HIGH LATITUDE DUST CLOUDS Ph.D. Thesis
Cornelis Pieter deVries 1986 211 p
(B8621135; ETN-88-92478) Avail: NTIS HC A10/MF A01

An automatic program for high resolution background analysis and object detection; calibrating stellar magnitudes by means of sub-beam prism photographic plates; surface brightness and extinction in the RCW 38 area and the Taurus clouds; distances and extinction maps of high latitude cirrus dust clouds; comparison of optical and infrared observations of cirrus dust clouds; and a warm dust cloud associated with alpha Cam are discussed. ESA

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics.*

N88-23710# Weather Wing (5th), Langley AFB, Va.
COMPUTING BASIC SOLAR AND LUNAR DATA FROM THE AIR ALMANAC Final Technical Note
John K. Sanders, Charles R. Elliott, and George T. Gilligan, Jr. Dec. 1987 57 p
(AD-A190777; Rept-5WW-TN-87-001) Avail: NTIS HC A04/MF A01 CSCL 03A

This Technical Note provides programmed instruction on the use of the Air Almanac to compute times of sunrise, sunset, moonrise, moonset, and duration of civil twilight for any location between latitudes 60 deg S and 90 deg N. Appropriate basic astronomy is included. This Technical Note updates and supersedes 5WW/TN-79/002. GRA

N88-23697# Kyoto Univ. (Japan).
DUST AND C2-CONTENTS IN THE COMA OF HALLEY'S COMET (1986III)
Tokuhide Akabane, Yoichiro Hanaoka, Kyosuke Iwasaki, Shingo Kawakami, Yoshihiro Nakai, Sumisaburo Saito, and Akitsugu Takeuchi *In its* Memoirs of the Faculty of Science, Kyoto University. Series of Physics, Astrophysics, Geophysics and Chemistry, Volume 37, No. 2 Mar. 1988 p 283-290 (For primary document see N88-23694 16-89)
Avail: NTIS HC A11/MF A01

N88-23698# Kyoto Univ. (Japan). Dept. of Astronomy.
PHOTOGRAPHIC OBSERVATIONS OF THE LARGE SCALE FEATURES OF COMET HALLEY
T. Tsujimura, J. Kubota, Y. Hanaoka, S. Kawakami, and T. Kogure *In its* Memoirs of the Faculty of Science, Kyoto University. Series of Physics, Astrophysics, Geophysics and Chemistry, Volume 37, No. 2 Mar. 1988 p 291-301 (For primary document see N88-23694 16-89)
Avail: NTIS HC A11/MF A01

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-23711*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MANNED MARS MISSION ACCOMMODATION: SPRINT MISSION
William M. Cirillo, Martin J. Kaszubowski, J. Kirk Ayers, Charles P. Llewellyn (PRC Systems Services Co., Hampton, Va.), Deene J. Weidman, and Barry D. Meredith Apr. 1988 157 p
(NASA-TM-100598; NAS 1.15:100598) Avail: NTIS HC A08/MF A01 CSCL 03B

The results of a study conducted at the NASA-LaRC to assess the impacts on the Phase 2 Space Station of Accommodating a Manned Mission to Mars are documented. In addition, several candidate transportation node configurations are presented to accommodate the assembly and verification of the Mars Mission vehicles. This study includes an identification of a life science research program that would need to be completed, on-orbit, prior to mission departure and an assessment of the necessary orbital technology development and demonstration program needed to accomplish the mission. Also included is an analysis of the configuration mass properties and a preliminary analysis of the Space Station control system sizing that would be required to control the station. Results of the study indicate the Phase 2 Space Station can support a manned mission to Mars with the addition of a supporting infrastructure that includes a propellant depot, assembly hanger, and a heavy lift launch vehicle to support the large launch requirements. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N88-23712# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 520, DECEMBER 1987. PART 1: (PROMPT REPORTS). DATA FOR NOVEMBER 1987, OCTOBER 1987 AND LATE DATA
Helen E. Coffey, ed. and John A. McKinnon, ed. Dec. 1987 100 p
(Contract N00014-86-F-0049)
(PB88-164199; SGD-520-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A05/MF A01 CSCL 03B

Solar-geophysical data contained include: detailed index for 1987; data for November 1987 (advanced and worldwide IUWDS alert periods, solar activity indices, solar flares, solar radio emission, and Stanford mean solar magnetic field); data for October 1987 (solar active regions, sudden ionospheric distrubances, solar radio spectral observations, cosmic ray measurements by neutron monitor, geomagnetic indices, and radio propagation indices); and late data (cosmic ray neutron monitor Huancayo July 1987, and geomagnetic indices August-September 1987). GRA

N88-23713# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
OBSERVATION OF NONLINEAR WAVE DECAY PROCESSES IN THE SOLAR WIND BY THE AMPTE IRM PLASMA WAVE EXPERIMENT
H. C. Koons, J. L. Roeder, O. H. Bauer, G. Haerendel, and R. Treumann 5 Feb. 1988 30 p Original contains color illustrations
(Contract F04701-85-C-0086)
(AD-A191409; TR-0086(6940-06)-14; SD-TR-88-18) Avail: NTIS HC A03/MF A01 CSCL 03B

Nonlinear wave decay processes have been detected in the solar wind by the plasma wave experiment aboard the AMPTE-IRM spacecraft. The main process is generation of ultra-low-frequency ion-acoustic waves from the decay of Langmuir waves near the electron plasma frequency. Frequently this is accomplished by an enhancement of emissions near twice the plasma frequency. This enhancement is most likely due to the generation of electromagnetic waves from the coalescence of two Langmuir waves. These processes occur within the electron foreshock in front of the earth's bow shock. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N88-23714*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
BRYNTRN: A BARYON TRANSPORT COMPUTER CODE, COMPUTATION PROCEDURES AND DATA BASE
John W. Wilson, Lawrence W. Townsend, Sang Y. Chun, Warren W. Buck, Ferdous Khan, and Frank Cucinotta (Old Dominion Univ., Norfolk, Va.) Jun. 1988 43 p
(NASA-TM-4037; L-16432; NAS 1.15:4037) Avail: NTIS HC A03/MF A01 CSCL 03B

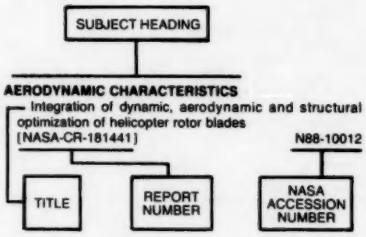
The development is described of an interaction data base and a numerical solution to the transport of baryons through the arbitrary shield material based on a straight ahead approximation of the

Boltzmann equation. The code is most accurate for continuous energy boundary values but gives reasonable results for discrete spectra at the boundary with even a relatively coarse energy grid (30 points) and large spatial increments (1 cm in H2O). Author

99 GENERAL

No abstracts in this category.

Typical Subject Index Listing



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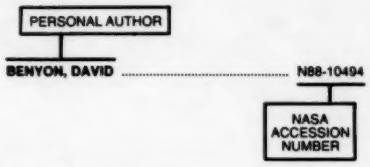

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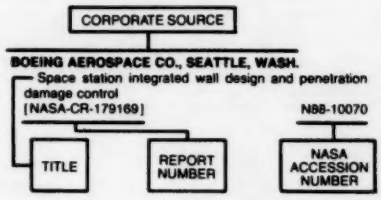

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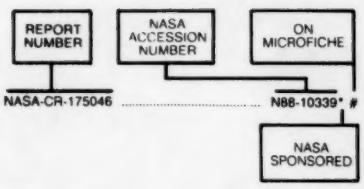

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